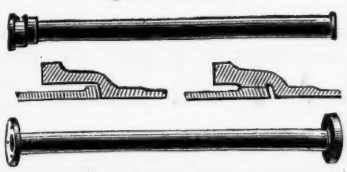
THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXIX. No. 1774.] LONDON, MAY 11, 1897. [49TH YEAR. PRICE 6d.

GAS AND WATER PIPES

1½ to 12 IN. BORE.



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SPECIALLY CONSTRUCTED FOR THE

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Wind, Rain, and Dust Proof.
Enamelled Steel throughout.
Made for One, Two, Three, and Five Lights.

The undisputed great advantages of the **Incandescent System of Gas Lighting** are frequently prejudiced by atmospheric influences upon the Mantles or by sudden gusts of wind.

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Each Lantern complete; nothing to get out of order; and no skill is required in fixing.

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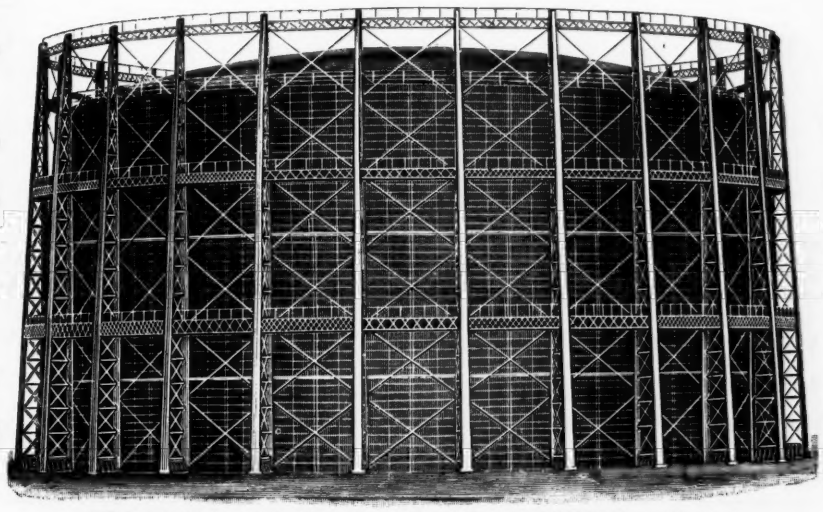

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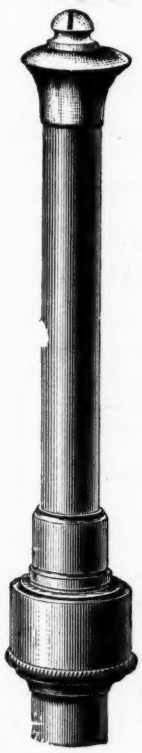

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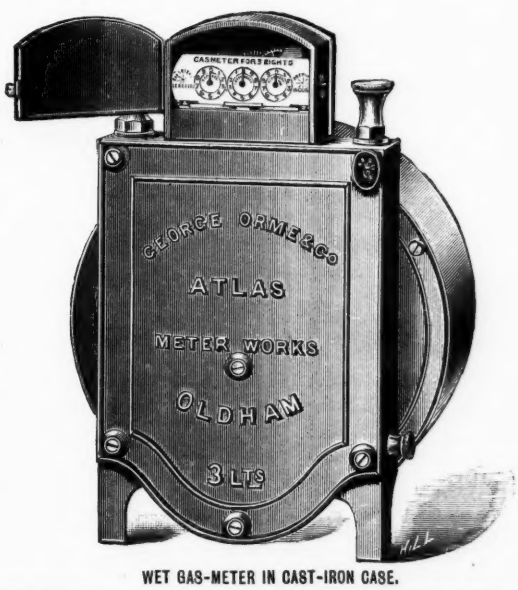

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SCREWS of all sizes.
GASHOLDERS,
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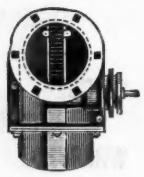

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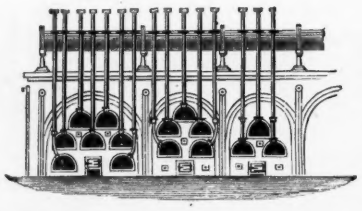

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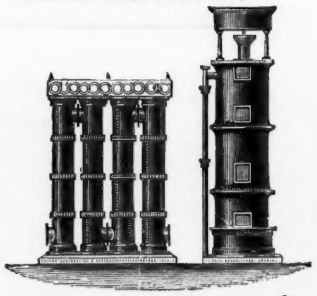

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CENTRE-VALVES
for working Purifiers,
Also Bye-Pass & Stop Valves,

PURIFIERS with Planed Joints,
HAND and HYDRAULIC LIFTING GEAR, CAST-IRON MAINS, and SPECIALS.
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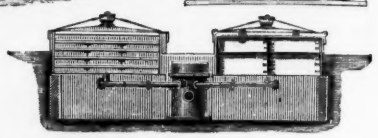

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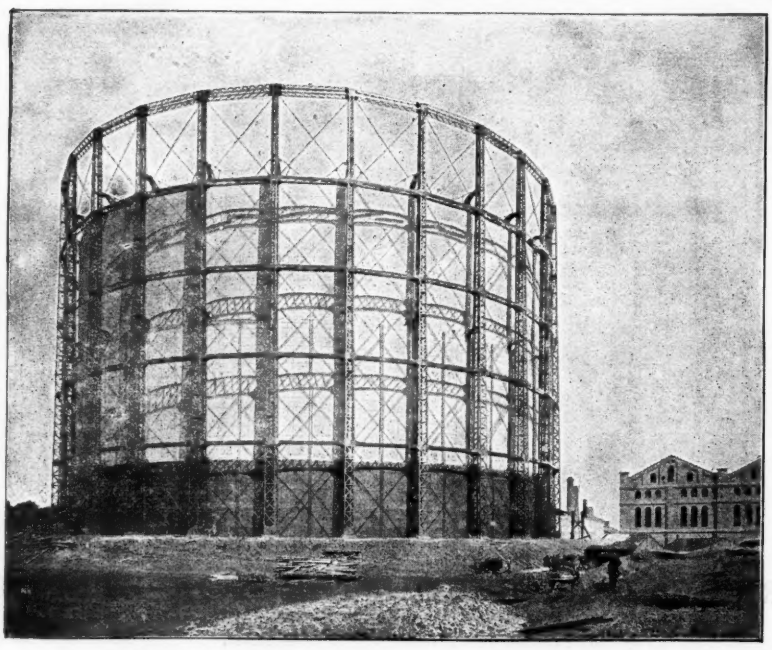

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GUIDE-FRAMING

STRONG,
SAFE,
CHEAP.

Has been adopted for many important Gasholders, and is in course of construction for

IPSWICH,
Three-Lift, 122 feet by 32 feet.

CRAYS,
Two-Lift, 78 feet by 26 feet.

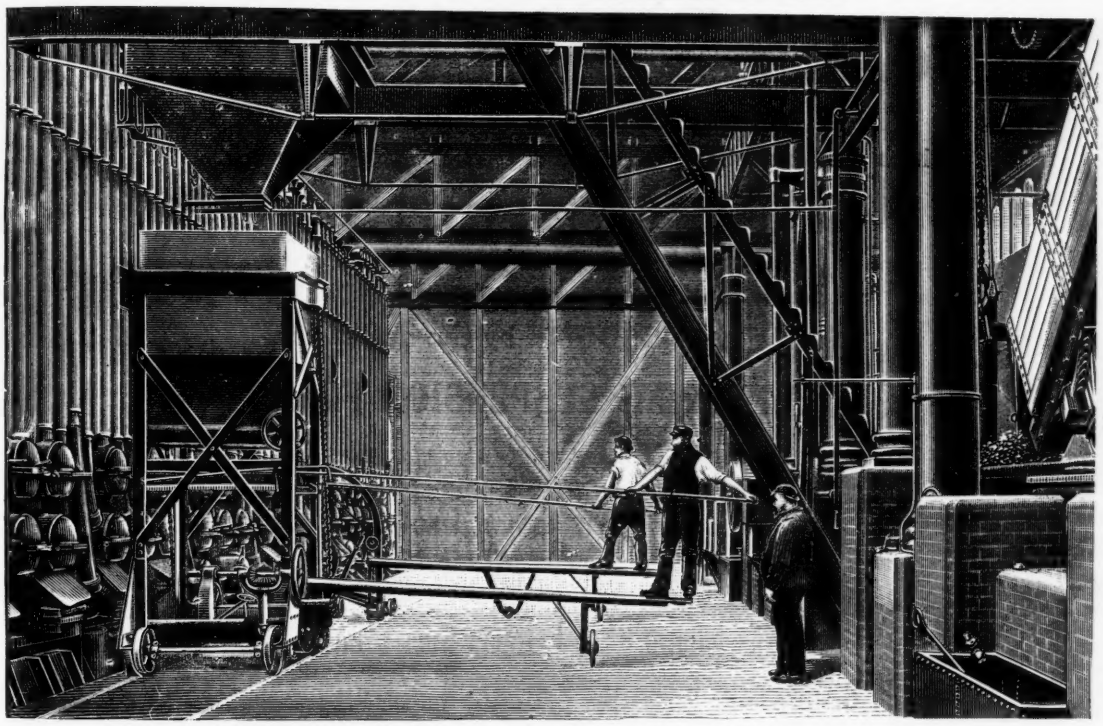
THE "COLONEL," DESIGNED BY G. C. TREWBY, Esq.
Erected at Kensal Green for The Gaslight and Coke Company.
CAPACITY 7,600,000 CUBIC FEET.

WEST'S GAS IMPROVEMENT CO., LTD.

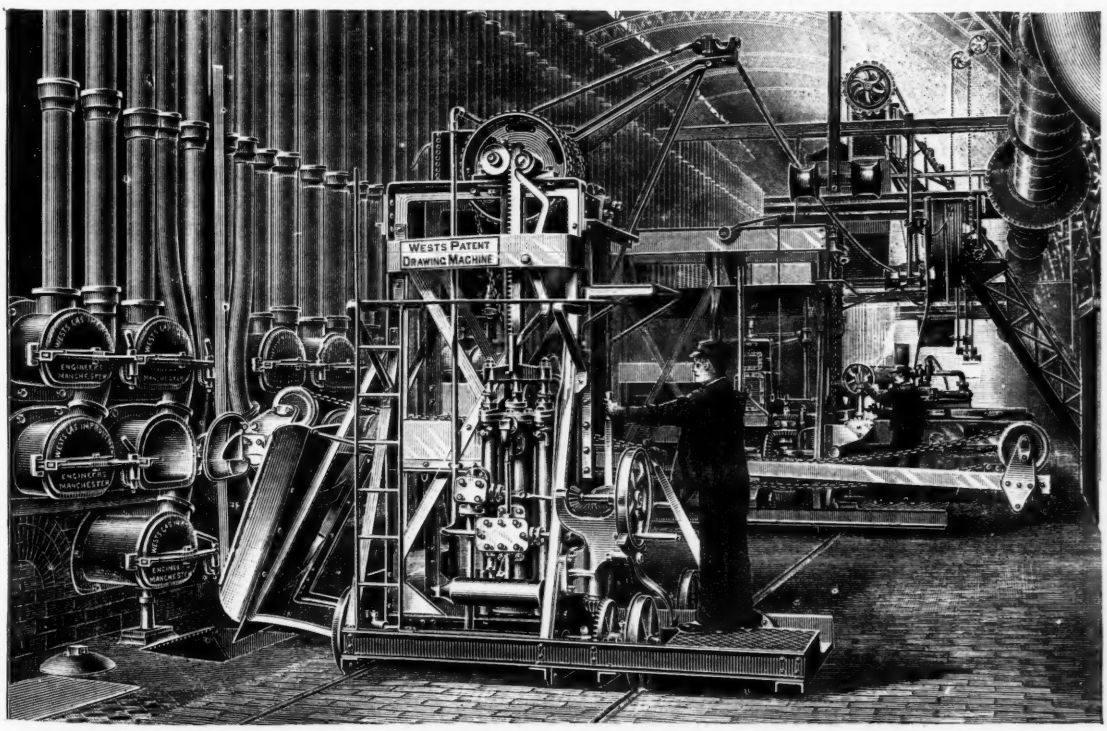
ALBION IRON-WORKS, MILES PLATTING,

MANCHESTER;

And 104, Queen Victoria Street, London, E.C.



West's Manual Charging and Drawing Machines.



West's Compressed-Air Drawing and Charging Machines.

Contractors for

WEST'S REGENERATOR SETTINGS & RETORT-HOUSE PLANT.

IMPROVEMENTS IN STREET LIGHTING.

Highest Efficiency with Greatest Economy.

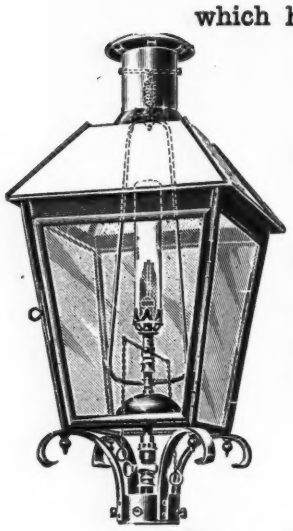
LIGHTING AUTHORITIES, GAS ENGINEERS, and GAS MANAGERS

are invited to inspect the

INCANDESCENT GAS-LIGHT

(Welsbach System),

which has now been successfully adapted to the purposes of

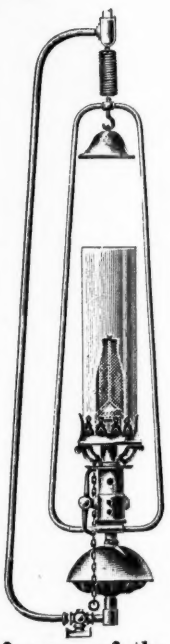


STREET LIGHTING,

the difficulties caused by VIBRATION having been OVERCOME by the use of the

NEW SPRING SUSPENSION FRAME (Patent).

This System of Lighting meets the requirements of all Lighting Authorities in those Districts where it is desired to effect an Improvement in Street Lighting WITHOUT INCREASE OF EXPENDITURE.



The following are Extracts from a PAPER read by Mr. F. G. DEXTER, before the SOUTHERN DISTRICT ASSOCIATION.

"The success of the experimental (Welsbach) lighting secured the contract for one of the Parish Council Districts; and this was shortly followed by the contract for three years for the city lamps. The total represents altogether about 500 single lamps, and 15 refuge lamps containing two lights."

"In the matter of maintenance of the street lights, the record is favourable—in fact, more so than the estimate provided. By the test-meter, the average daily consumption works out to 38 cubic feet per light, including bye-pass. The bye-pass consumes with a flame half an inch long, $\frac{1}{5}$ foot per hour. This represents 1000 cubic feet per lamp per annum. The average consumption per light, when in use, works out to 12,900 feet per annum, or about $3\frac{3}{5}$ feet per light per hour. The lighting is continued all the year round, from the average times of one hour after sunset to one hour before sunrise."

"The mantles have worked out to an average of three per lamp per annum; but, bearing in mind the absence of frost last winter, the writer believes that four mantles per light is more likely to represent average conditions."

"In the matter of cleaning, it may be said that the lanterns require less attention than with the ordinary flat-flame burner."

"The number of lights attended to per man averages 85."

"The 'Welsbach' Light is undoubtedly one of the greatest aids to successful competition that the Gas Industry has ever experienced. Its influence, while reducing the relative cost of light, has advanced the consumption of gas all over the country by the increased satisfaction of the existing consumers, and the attraction of others. The writer feels that its influence should not be confined to the house. It is capable of meeting every competitor in the street, from cheap oils to arc lights, in cost and in effect; and it is hoped that the foregoing experience may lead many others to seek its aid and to realize its efficiency."

FOR PRICES AND PARTICULARS, APPLY TO THE

INCANDESCENT GAS-LIGHT CO., Ltd.,

Palmer Street, Westminster, London.

TELEGRAMS, FIRECLAY, LEEDS.
TELEPHONE No. 612.

CONTRACTORS FOR EVERY DESCRIPTION OF GAS WORKS PLANT.

THE LEEDS FIRECLAY CO. (LIMITED)
Engineering Department,
WORTLEY, LEEDS.

BRANDS
"CLIFFS,"
"INGHAMS,"
"BROOKES."

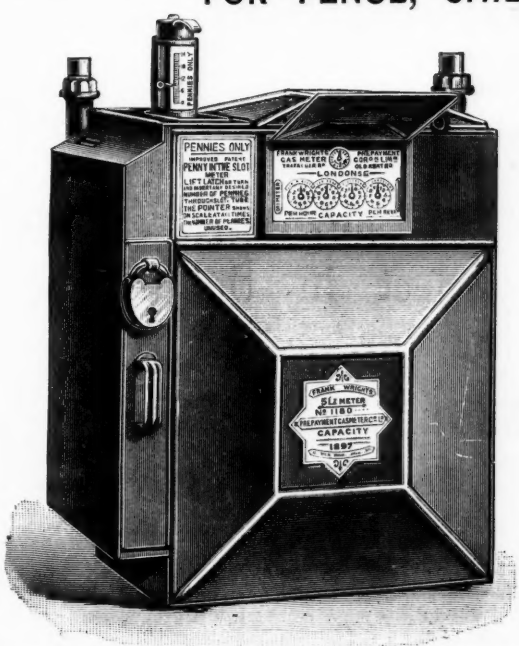
SPECIALITIES

HORIZONTAL AND INCLINED RETORT SETTINGS AND IRONWORK.
COAL & COKE ELEVATING, CONVEYING, AND STORAGE PLANT.
RETORT HOUSE WORK GENERALLY.

MANUFACTURERS OF
HORIZONTAL and INCLINED
Machine and Hand Made
RETORTS,
BRICKS, BLOCKS, TILES, &c.

The Company are also prepared to undertake the RE-SETTING OF RETORTS in existing benches. Enquiries invited.

THE "TRAFALGAR"
PREPAYMENT GAS-METER
FOR PENCE, SHILLINGS, OR ANY COINAGE.



THE ADVANTAGES OF THIS SYSTEM ARE:

1. Simplicity of Mechanism.
2. Absolute Accuracy.
3. Impossibility of being tampered with.
4. Unaffected by irregularities in shape or thickness of the penny.
5. Can be fixed to any ordinary Wet or Dry Meter.
6. Extra large Money-Box.
7. Price Changer can be altered without otherwise disturbing the Meter.
8. Index showing number of pennies in the mechanism at any time.
9. Rejection of half-pennies certain.

GUARANTEED FOR FIVE YEARS.

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WILLEY & CO., GAS ENGINEERS,

CONTRACTORS TO THE GOVERNMENT,

LONDON & EXETER.

Offices: HAVEN ROAD, ST. THOMAS, EXETER.

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Meter Factories & Works: JAMES STREET, EXETER; and 248, KINGSLAND ROAD, LONDON.

LATEST SPECIALITIES.

WATER-GAS APPARATUS—A Model Plant in course of erection at their Exeter Engineering Works. Continuous Process; the best Results yet attainable.

COLUMNLESS GASHOLDERS—Makers of Gadd & Mason's Patent System.

Agents for the **MAXIM CARBURETTOR.**

GAS ENRICHMENT in bulk or on Outlet Main.

Makers of the **LIVESEY WASHER.**

Manufacturers of **WET AND DRY GAS-METERS.**

Their Patent **PENNY-IN-THE-SLOT AUTOMATIC METER,** admittedly one of the most perfect in the Market. Thousands in use in London and the Provinces.

Manufacturers of **GAS-FITTINGS** in endless variety—**CHANDELIERS, BRACKETS, PENDANTS, MAIN COCKS, &c., &c., &c.** **SPECIAL FITTINGS** for the Automatic Business.

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SUNLIGHT INCANDESCENT GAS-BURNER.

Free from all Infringements.

EXTRACTS FROM THE JUDGMENT GIVEN BY THE

Hon. Mr. JUSTICE WILLS.

"No use is made by the Defendants of any of the 'rare earths;' and their choice of substances and their method of applying the illuminants appear to me to be as wide asunder as the poles from those contemplated by Welsbach."

Welsbach Company's Counsel "both admit that they have no case unless the Welsbach skeleton, of whatever resistant earth oxides composed, is within the Welsbach Patent. It seems to me that this is just what Welsbach did not claim."

THE FOLLOWING CERTIFICATE IS GIVEN WITH EVERY MANTLE:—

"**The New Incandescent (Sunlight Patent) Gas Lighting Company, Limited,** hereby certify that the within Mantle is in every respect similar in Process of Manufacture and constituent parts or substances to the Mantle which was held by the Hon. Mr. Justice Wills **NOT to be an Infringement of the Welsbach Patent.**"

PRICE LIST AND TERMS UPON APPLICATION.

THE NEW INCANDESCENT (SUNLIGHT PATENT) GAS LIGHTING Co., LIMITED,

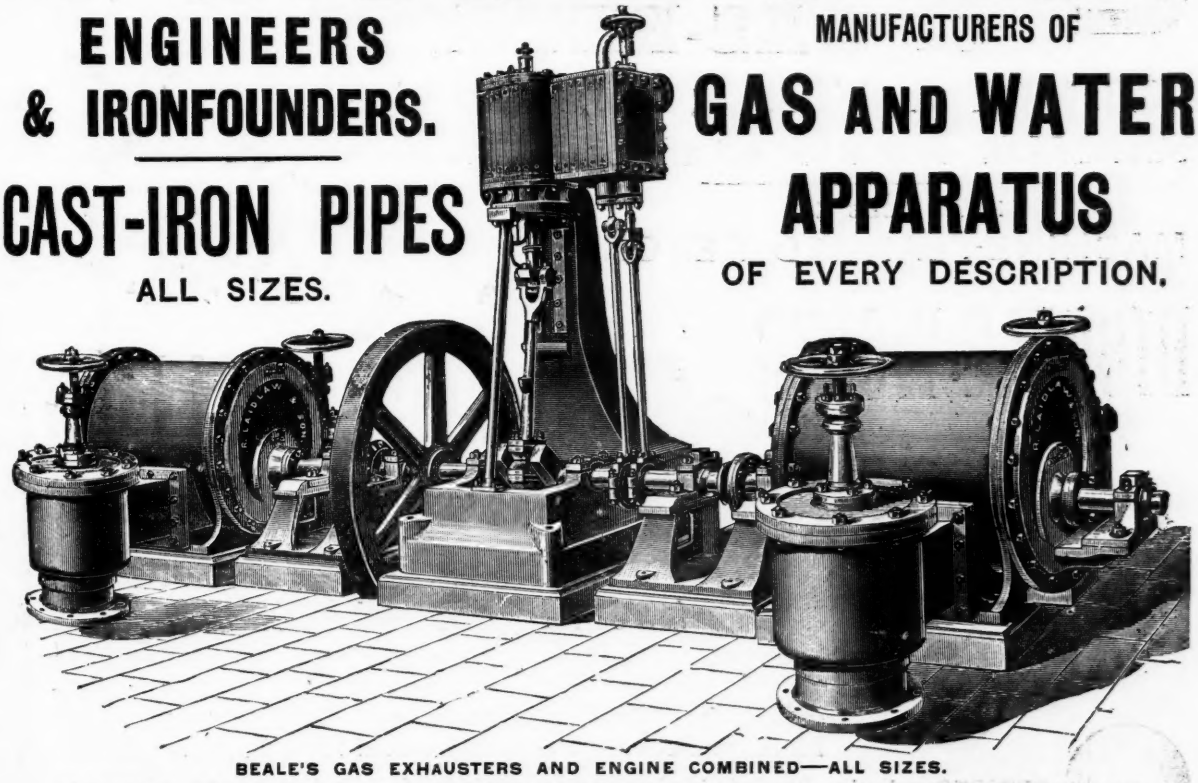
33 & 34, Shoe Lane, London, E.C.

R. LAIDLAW & SON

ENGINEERS & IRONFOUNDERS.

MANUFACTURERS OF GAS AND WATER APPARATUS OF EVERY DESCRIPTION.

CAST-IRON PIPES ALL SIZES.



BEALE'S GAS EXHAUSTERS AND ENGINE COMBINED—ALL SIZES.

ALLIANCE FOUNDRY, GLASGOW. | SIMON SQUARE WORKS, EDINBURGH. | 6, LITTLE BUSH LANE, LONDON, E.C.

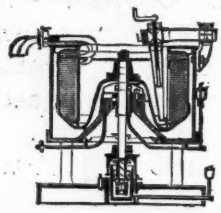
KIRKHAM, HULETT, & CHANDLER, LD.

3 & 4, PALACE CHAMBERS, BRIDGE STREET, WESTMINSTER, S.W.

MARSHALL'S PATENT COMBINED BATTERY CONDENSER AND SCRUBBER.

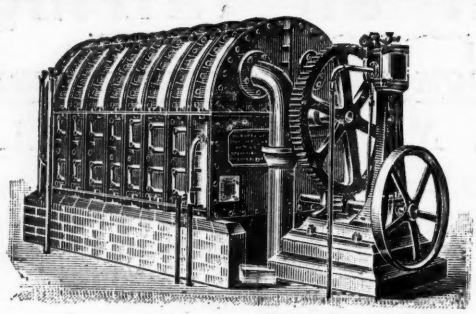
Extract from letter from Mr. Winstanley, of Coventry: 'The Condensers you erected for us have been in use some time, and are working very satisfactorily.'

BURMEISTER AND WAIN'S TAR-SEPARATOR.



EXTRACTS OVER 99 PER CENT. OF AMMONIACAL LIQUOR FROM TAR.

PATENT "STANDARD" WASHER-SCRUBBER.

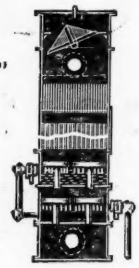


OVER 530 MACHINES

In use and in course of Construction.

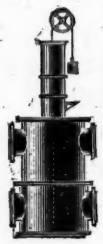
They extract all the Ammonia and a large proportion of Carbonic Acid and Sulphuretted Hydrogen.

PATENT "STANDARD" VERTICAL SCRUBBER AND TAR-EXTRACTOR.



SUITABLE FOR SMALL WORKS WITHOUT AVAILABLE MOTIVE POWER FOR MECHANICAL WASHERS.

MARSHALL'S PATENT TAR EXTRACTOR AND WASHER.



Extract from letter from the Late Mr. Jabez Church: "The Marshall Patent Tar-Extractor has given very satisfactory results."

THE WIGAN COAL & IRON CO., LIMTD.,

Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.

Midland District Office: PRINCE'S CHAMBERS, 6, CORPORATION STREET, BIRMINGHAM—Sole Agent: A. C. SCRIVENER.

TELEGRAPHIC ADDRESS: "WIGAN BIRMINGHAM." TELEPHONE No. 200.

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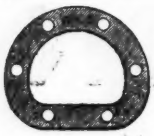

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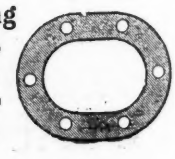

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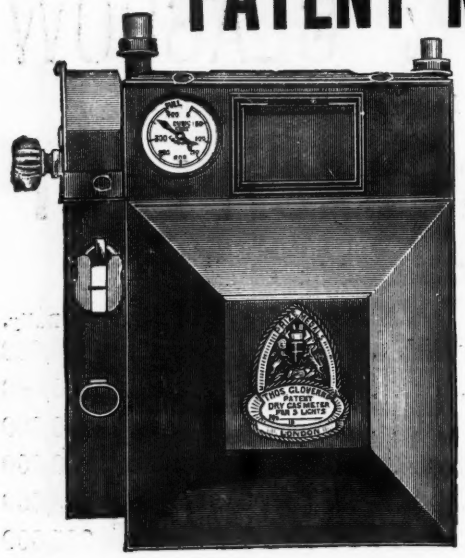

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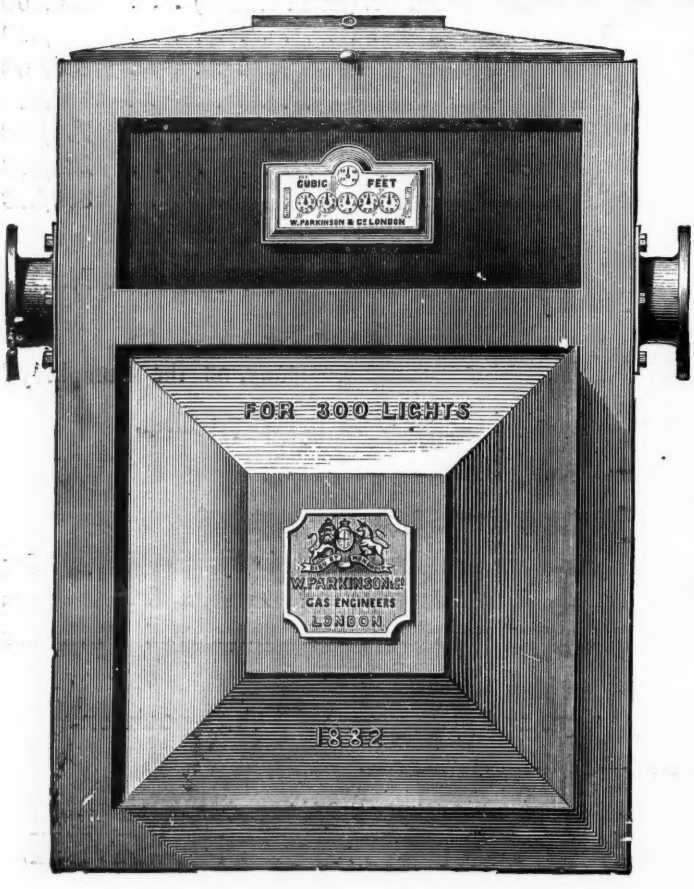

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EDITORIAL NOTES.

The Meeting of the Institution of Gas Engineers.

THE meeting of the Institution of Gas Engineers last week, under the presidency of Mr. Corbet Woodall, was the most successful, as regards attendance, in the history of the organization. A good deal of the attraction on this occasion is doubtless to be found in the personality of the President, who occupies an exceptional and quite unprecedented position in the gas industry, not merely of this country, but also of the European Continent. Mr. Woodall is a Cosmopolitan Gas Engineer, and under his influence the Institution is fast assuming an international character. In this way it will be possible for it to attain a standing and occupy a sphere which no other society of the kind has attempted to reach. It is unnecessary to dilate here upon the future possibilities that lie before an Institution once fairly started upon such a line of development. The gas industry is universal; and though its methods vary slightly with its *habitat*, yet on the whole there is perhaps a greater degree of uniformity in gas engineering practice throughout the world than can be found in railway construction or any other branch of civil engineering. Certainly, when gas engineers and managers meet, though they may come from the ends of the earth, they can always find much common ground to foregather upon. If there is to be an international technical society for the cultivation of gas engineering science, the Institution would appear to be marked out for this part. The industry is of British origin, and by common consent it has been carried to its fullest technical and commercial development in this country. If there is any organization in existence from the members of which, taken collectively or individually, the most authoritative judgments upon any point of professional concern might be expected, it is this particular Institution; and there can be no reason why other societies at home or abroad should be jealous of its attractions.

Mr. Woodall has done, and will continue to do, good service to the Institution and the gas industry of every Continent by throwing his great personal influence into the cause of the Institution. He performed the rest of his part last week with supreme ability and tact; and by arranging for the autumn meeting to be held in Amsterdam, under the auspices of the Imperial Continental Gas Association, he has touched a height of popularity that places beyond the reach of criticism his conduct in the chair. It may seem cruel to say after this that the recent meeting left something to be desired. But the truth will out; and it is a regrettable fact that the papers read were not up to the mark. We do not say that, as contributions to technical literature, they were poor or badly written. Indeed, when they come to be collected in the "Transactions" of the Institution, in all the pomp of large type, they will appear stately enough. Some of them are also full of sound information concerning the subjects of which they treat; and they all exhibit a high standard of endeavour. Where they generally disappointed the meeting was in their conspicuous lack of debateable suggestion. Members must have felt—and in many cases they certainly did feel—that there was little of actual interest for the majority in much of the matter brought before them. Consequently, the discussions were neither full nor particularly vivid. It is always to be regretted when a large number of professional men are gathered together from all parts, and there is nothing done to draw them out. The difficulty of getting good papers of the right stamp is understood; but what is the good of a Council if they cannot grapple satisfactorily with this trouble? The President has his own work to do; and this year, as in former years, the Institution has been fortunate in its President on several counts. If it had not been so, the meeting last week would have seriously affected the reputation of the Institution. The President did his duty, and more; and the members turned up in creditable strength. The Council must see to it that the papers next time give them something more to talk about, or they will begin to consider the advantages of staying at home, and reading the papers in the "JOURNAL," instead of putting themselves to the trouble of attending the meeting.

We do not wish that our final words upon last week's gathering should be those of criticism; and therefore we will repeat with emphasis that the meeting showed how strong the Institution is becoming in its own line, and how

unique is the position in the technical world which it is apparently tending to occupy. Those who attended were amply repaid for their pains; and the glowing anticipations raised as to the autumn excursion sent them home in the best of spirits to await this "next merry meeting."

The Verdict in the Samson Fox Libel Suit.

After a trial unprecedented for its kind in length and the complexity of the evidence, a Middlesex Special Jury have found that Mr. Samson Fox was libelled by the publication called "To-Day" in respect to his proceedings as promoter of the New Leeds Forge and the Water Gas Companies of 1889, and have assessed at one farthing the consequent damage to his reputation. When the character and intention of the journalistic libels in question are remembered, it will be understood that this result must be anything but gratifying to the ingenious individual whose wounded honour is thus compensated. We have reported so much of the proceedings in this suit as relate to technical matters; but our readers are aware that a great mass of evidence bearing upon the financial and other aspects of the case has also been given, and that Counsel on both sides have said a great deal more about Mr. Fox than we have been able to publish. For the defence, Sir Frank Lockwood, Q.C., has worked throughout with indomitable energy, and has displayed a grasp of the nature of the technical and other questions involved such as abundantly justify his high position at the Bar. On the plaintiff's side, Sir Edward Clarke, Q.C., has wrought wonders of persuasive eloquence out of materials that would have broken the heart of a less capable advocate. Even Sir Edward, however, could not make out Mr. Fox to be a person with whose case a British jury should have much sympathy; and though, in a fine burst of eloquence, Counsel asked what money compensation could atone for having to sit in Court a whole day listening to the torrents of contumely poured out by Sir F. Lockwood on the unhappy man who had ventured to bring the action, the jury have thought that the coin of least value in the currency is sufficient for the purpose. This shows what they think of Mr. Samson Fox. The jury also seem to have considered that something in or about the publication of the libels was not justified; and consequently they have not given their verdict for the defendants. There remains the question of costs, which had not been disposed of at the moment of writing.

We are sorry defendants did not gain the day out and out; but this they perhaps hardly expected themselves. To tell the truth, the attack of "To-Day" upon Samson Fox, though well directed, was a little too audacious in manner to command the approval of a British judge and jury. That journal was justified in protesting against the ascription of any sort or degree of public praise to Mr. Fox for his artfully-calculated donation of £45,000 to the Royal College of Music; and if the subsequent exposure of the kind of success achieved by this person had been more restrained in tone, it would probably have been quite as useful and would almost certainly have cleared its authors in the estimation of the Court. As it was, the whole tone of the articles in "To-Day," true as they were in the main, was too closely modelled on the style of the "New Journalism" to please a fastidious taste, such as appears to have ruled in Baron Pollock's Court; and they stated some things which it was impossible to prove. To nothing else can we ascribe the result of such a trial. Our own record in the matter is clear. Before the financial operations of Mr. Fox in water gas had fully developed, we condemned the whole thing; and our attitude in this regard has never wavered. We observed, indeed, at the time that a day of reckoning would come for the promoters of the Water Gas Companies of 1889; and the prophecy has been fulfilled. Nobody was to know how and when Samson Fox, Cottam, and the others, would be brought to book. Mr. Labouchere, it is notorious, has made his journal "Truth" a sort of pillory for offenders of the classes left alone by the Crown officials; and Mr. Jerome is following suit with "To-Day." This is obviously an unsatisfactory method of dispensing justice; but there does not seem to be any other way of effectively dealing with those cases which lie on the borderland between criminality and commercial sharp practice. The "personal" journal, in brief, is the milder modern substitute for Lynch law in the chastisement of offenders whom, for any reason, the regular law does not reach. Returning to the Samson Fox case, it is so far satisfactory to reflect that the verdict definitely consigns him and his associates in these company-promoting performances to the cold shade of irremovable disgrace. He, for one, seems to have retained some of the wherewithal to render life endurable in the material aspect; but, especially after the exposure of his conduct in bribing the Head Surveyor of Lloyds—which, of course, "had nothing to do with the case"—it is something to be thankful for that this centre of corruption will henceforward cease from English industrial life. Fox has his money; now increased by one farthing. Much good may it do him.

The Workmen's Accidents Compensation Bill.

On Monday of last week, the Government Bill to amend the law of employers' liability for injuries sustained by workmen in the course of their employment was introduced by the Home Secretary, and read the first time. It bears out in a remarkable degree the expectations we framed in our last respecting its probable scope. The provisions of the measure are not precisely similar to those of any previous scheme of legislation of the kind, though it has a general resemblance to the leading features of Sir A. Forwood's Bill. The differences are, in the main, improvements. Arrangements are contemplated to enable workmen and employers to enter into private contracts for compensation; but it is also provided that no such agreements are to exempt employers from the consequences of wilful or wrongful acts or defaults on their part by which workpeople suffer injury. This is a highly important consideration. Again, the question as to whether any private scheme of compensation or insurance is, on the whole, not less favourable to the workman than the provisions of the Act, is made referable to the Registrar of Friendly Societies. The maximum amount of compensation under the Act is, in the event of death, to be from £150 to £300, or the equivalent of the last three years' earnings, whichever sum is the larger. If the victim leaves no dependants, compensation is to be limited to the reasonable expenses of his medical attendance and burial, not exceeding £10. In the event of incapacity for work, there is to be a perpetual weekly payment not exceeding 50 per cent. of the man's earnings at the time of the accident, such payment not to exceed £1. At present, the Bill only applies to employment on railways, or in factories, mines, quarries, or engineering works. The latter term includes works of construction of railroads, harbours, docks, canals, or sewers, besides any building or other work on which power machinery is used. These definitions appear to need more careful consideration. Taking it in its entirety, we are disposed to think the Bill a good one, and honestly meant to improve the condition of workpeople in the several trades to which it applies. It does not, in so many words, abolish the doctrine of common employment; but it does so in point of fact, which is better. It affords little handle for the speculative lawyers to lay hold of in any case, which is more than could be said of Mr. Asquith's Bill. Of course, the wire-pullers of the fighting Trade Unions will not like the measure, which cuts a good deal of ground from under their feet; but the House of Commons is not so much under the domination of these gentry as it was when Mr. Asquith was the Home Secretary. The provisions dealing with the private arrangements of masters and men are conceived in a liberal spirit, and are not of a character to create any undue friction in working. All these points, however, need to be tested by reference to actual experience, which every employer can do for himself. If the Bill passes, employers will, as a matter of course, insure against the new risk, where there are no accident funds. But this charge would in every case be small; and the relief of having made matters safe for both parties in this respect will be no small compensation for the outlay.

WATER AND SANITARY AFFAIRS.

The constitution of the Royal Commission appointed to inquire into the question of the Metropolitan Water Supply is a matter of very direct interest and importance. Somewhat contrary to expectation, the Commission is a little larger than that presided over by Lord Balfour of Burleigh in 1892-93; the members being eight in place of seven. The new Commission happens also to have one member who was engaged under Lord Balfour—namely, Sir G. B. Bruce, C E., a Past-President of the Institution of Civil Engineers. That Lord Llandaff should be the Chairman appears consistent with his Lordship's former position as

Home Secretary, when known as Mr. Henry Matthews. Mr. J. W. Mellor, Q.C., M.P., will be capable of rendering valuable service, judging by the discernment which he displayed when, while occupying the post of Chairman of Committees, he cautioned the House of Commons against rejecting the East London Water Bill of 1893. Sir John Dorington, M.P., will bring his experience to bear as having been Chairman of numerous Select Committees. The qualification of Mr. H. W. Cripps, Q.C., may be inferred from his antecedents as a member of the Parliamentary Bar, having been the leading Counsel for the late Metropolitan Board during many years of its existence, though perfectly independent of the present Council. Major-General A. de Courcy Scott, R.E., is well chosen as being familiar with the many details continually brought under his observation as the Water Examiner appointed under the Metropolis Water Act of 1871. We suppose there is some good reason for placing Mr. A. de Bock Porter, C.B., among the Commissioners, though at present he is only known to us as the Secretary of the Ecclesiastical Commissioners. The remaining member to be accounted for is Mr. Robert Lewis. For Secretary there is Mr. Cecil Owen, who was Private Secretary to Sir Arthur Arnold when the latter was Chairman of the County Council. Mr. Owen was also Secretary to the Welsh Land Commission; and in connection with the present Royal Commission he appears to be the right man in the right place.

The duties of the Royal Commission as now called into existence are, of course, defined by the terms of reference. These extend to considerations altogether outside the range of Lord Balfour's inquiry. The Commission appointed in 1892 had to deal mainly with the question whether a supply, adequate in quantity and satisfactory in quality, could be obtained within the watersheds of the Thames and the Lea, so as to meet the requirements of the Metropolis and the outlying districts, taking into consideration the growth of the population. The answer to this interrogation was in the affirmative, in relation to a long series of years. This point being determined, questions of finance and management now come in; and the new Commission has to advise whether or not it is worth while to buy up the undertakings of the Water Companies, and, if so, what provision shall be made for their future management. If the Commissioners decide against the acquisition of the undertakings, they will have to say whether additional powers of control should be exercised by local or other authorities. Some subsidiary questions are involved. But such is the broad outline; and the alternative rests between purchase and control. Lord Balfour's Commission reported unanimously on the matters it had to consider; but, looking at the constitution of the present Commission, and the questions referred to it, we can hardly expect such a result. There might perchance be a general agreement for purchase; but a difference seems inevitable as to the parties who should have possession. The Commission of 1892 had simply to deal with physical facts. Lord Llandaff and his colleagues will have to encounter interests of a more personal nature, in which party feeling is largely concerned. If the Commission is to effect anything, it must present a unanimous report. Should the conclusions be of a divided character, it will accomplish nothing towards a settlement of the Water Question. But whether divided or unanimous, we may rest tolerably assured that it will be some time before the report makes its appearance. To the Progressives, the range of the inquiry must appear painfully circumscribed, as it leaves no obvious opening for the Welsh supply. It also places in the foreground the awkward topic of finance as affecting the ratepayers.

The Finance Committee of the London County Council, in preparing the estimates for the year ending March 31, 1898, to be considered at the meeting of the Council to-day, have set down £2500 as requisite to defray the cost of preparing evidence to be laid before the Royal Commission on the London Water Supply. Either prejudging or disregarding what may be the conclusions arrived at by the Commissioners, it is proposed that the Council shall expend £5000 in the conduct of inquiries into areas of supply, and in other ways, with a view to the promotion of a Bill in Parliament relative to the water supply. Thus the total vote, as proposed, becomes £7500, following on an expenditure of more than £4000 in the same direction last year.

THE INCORPORATED INSTITUTION OF GAS ENGINEERS.

PROCEEDINGS AT THE GENERAL MEETING,

HELD AT THE

INSTITUTION OF CIVIL ENGINEERS,

MAY 5TH & 6TH, 1897.

Mr. CORBET WOODALL, M.Inst.C.E., President.

REVIEW OF PROCEEDINGS.

THIS year's May meeting of the Institution of Gas Engineers was looked forward to with an exceptional degree of interest and expectation, proceeding mainly from the personality of the President-Elect, Mr. Corbet Woodall. From being a leader of the profession in the United Kingdom, Mr. Woodall has during recent years acquired an equally exalted position in connection with the advancement of the gas industry by that truly international enterprise, the Imperial Continental Gas Association. Nor has his later experience been confined to the Continent of Europe, for America and the Cape have also come within the range of his energies; so that he has risen to a quite unprecedented eminence as an exemplar of the gas engineering profession of the day. It was consequently felt on all hands that, with a President of such credentials, the meeting of the Institution for the present year was likely to amply repay those members who could take part in it. This reasonable expectation has not been disappointed. The meeting was very well attended, by a distinguished and interested company of engineers hailing from all parts of the world, not one of whom but would now be willing to confess that it had been well worth his while to be there. The reconstructed building of the Institution of Civil Engineers is a perfect place of assembly for a technical society on business bent. The weather was favourable; and the quality of the address and the communications, as a rule, high. Moreover, a spirit of good-fellowship permeated the meeting through and through; and there was a complete absence of everything that could mar such a function.

Of presidential addresses there is nowadays such great plenty, that whenever a fresh effort of the kind is made, the audience may be pardoned for feeling slight trepidation as to how it is likely to go off. Mr. Woodall succeeded in realizing the character of his responsibility in this regard in a style that more than justified his reputation. Refraining—wisely, as we think—from any vain attempt to tell his hearers anything concerning those points of technical practice upon which such an audience would be likely to be at least just as well posted as himself, the President accepted frankly the part of the "consultant," which fits him so well. Like the philosopher described by Carlyle, he was content to get upon the watch-tower of a long and still growing experience of men and matters, and from this eminence to tell the world, which is so prone to forget the fact, what the time of day really is. The year of the "Diamond Jubilee" reign naturally encourages reminiscence; but, while submitting to the pervasive influence, Mr. Woodall did not try to interest his hearers in a review of sixty years' gas engineering work. It happens that nineteen years ago he was President of the British Association of Gas Managers; and this reflection supplied the starting-point for a suggestive recapitulation of the nature of the development of the gas industry since this era. To those who remember the meeting of 1878, it does not seem so very long ago. Mr. Woodall himself, though his black hair has changed to grey, is hardly altered a whit. Yet when one pauses to think it over, the gas industry of to-day, as he observes, is a very different business from what it was in 1878. At that period, the electric light was just dawning upon the industrial horizon. The gas-furnace was in embryo; mechanical stoking was not; and the only ideal of improved carbonization was that of something "continuous," which has not led to anything. The use of portland cement concrete for gasholder tanks was still a venturesome experiment; the daring series of experiments in gasholder design initiated by Mr. George Livesey had not been begun. Not half-a-dozen gas undertakings were administered under the sliding-scale. The

gas-engine, the gas-kitchener, and the regenerative gas-burner were in existence; but that is all. Coal-handling plant and the Gas Workers' Union were in the future; and neither M. Coze nor Dr. Auer von Welsbach were known to the world. Illustrations to the same effect might be largely multiplied; but enough has been done by Mr. Woodall himself to remind the technical and the general public that the gas industry has developed as well as grown since 1878.

There is a strong thread of logical argument running through Mr. Woodall's address from beginning to end. He does not indulge in retrospect for the sake of saying something, albeit what he has to say is intrinsically interesting. He does not employ one superfluous word, or one redundant or merely rhetorical phrase. Everything is intended to lead up to the central position taken by the speaker, in his office of guide, philosopher, and friend of gas managers the world over—which is, that they have a great and growing industry to watch over and develop. Therefore, he tells them, they must fit themselves for their work according to the best fashion of these strenuous times. It is possible to read between the lines of his courteous periods such advice as the following: "He who would rise in his profession must begin with being a gentleman, and must have mechanics, chemistry, and electricity at his fingers' ends." This is perhaps a blunt way of rendering Mr. Woodall's polished cautions into their practical equivalents; but the translation is pretty accurate.

Mr. Woodall sees the necessity of raising the status of the gas engineering profession; and his words upon this head are words of solid wisdom. It is quite true that the members of a profession or calling must have self-respect first, if the world is to respect them or their calling. No outside assistance will avail to help men who fail to see this essential condition of advancement. It is so easy to take the lower way! There will never be any lack of tempters to the life of insidious shirking, of dull refusal of any attempt to realize the best possibilities of one's opportunity. If Mr. Woodall had never rendered any other service to the gas industry, his grave counsel to those who have entered or who may enter it with a view to making it the basis of a professional career, would suffice to give him high rank as one of its benefactors.

Another thing believed in by Mr. Woodall is the expediency of combining to some extent the study and practice of gas and electrical engineering. The passages of the address dealing with this subject are so reasonable and fairly expressed that we cannot paraphrase them with any advantage. Then, after briefly discussing the most conspicuous points of modern gas engineering practice—such as carbonizing by inclined retorts, carburetted water gas, and the newest applications of gas to the service of the community—the address concluded with a strong declaration in favour of Mr. Livesey's method of dealing with the labour problem. This, also, need not be discussed here. We take leave of the address at last with a feeling that, if it has not told us anything particularly new, it has helped us much in other ways. In this it faithfully reflects the individuality of the speaker. Mr. Woodall is not eminent because he is an inventor, or a doer of novel and startling things. He is, and always has been, the wise counsellor, the helpful friend, the prudent critic of affairs and men, who never made an enemy, nor shrank from speaking faithfully to a friend. There are none too many of such men in the world, where honest and kindly people find it hard enough to keep up with the procession. The presence at the head of his fellows of such men as Corbet Woodall, serves to keep many from giving up the struggle or going astray.

After the address, which was very well received, the interest of the meeting somewhat declined. The first paper taken was an academical production by Professor Smithells on the cause of the light of flames, which was indubitably clever, but as certainly was it uninspiring. Professor Smithells does not agree with Professor Lewes with regard to the cause of the luminosity of flames; and he said so at considerable length. But inasmuch as Professor Lewes was not present to answer him, and nobody else in the meeting knew very much of the point at issue, the paper did not seem to advance the controversy, such as it is. The second paper was by Mr. G. P. Lewis; and it went most exhaustively into the subject of the recovery of cyanides as a bye-product of gas manufacture. The paper can be commended to whomsoever wants to know all there is to be known respecting the actual condition of this question. It will therefore form a valuable contribution to the "Transactions" of the Institution. Having regard to the abstruse nature of the subject, the discussion was quite lively. The meeting was evidently glad of the opportunity afforded by the reading of the paper for threshing out a question which, so far as we are aware, has never before been brought to so definite an issue. It will not be a surprise to many who have looked into the matter purely from the commercial standpoint to learn that the general impression made by the paper and discussion was that cyanide recovery is hardly worth the attention of the average gas manager. There is always a certain fascination in the idea of recovering a previously wasted product, whether of gas or any other manufacture; but when there is not the additional attraction of a proprietary process to incite to diligence in this pursuit, the commercial consideration must settle the question of its expediency.

The Institution dinner on Wednesday night, held at the Trocadero Restaurant, was more successful than any previous function of the kind in the history of the organization. The President was supported by Mr. T. H. Goodwin Newton (the Chairman of the Imperial Continental Gas Association), Mr. John Aird, M.P., Mr. W. Woodall, M.P., Mr. E. B. Ellington, and Mr. Alfred East; and the company included nearly all the members of the Institution present in London.

The first paper taken on Thursday was a very circumstantial and carefully worked-out statement by Mr. C. E. Botley and his son, Mr. C. F. Botley, describing the authors' ingenious process for "carburating" gas. The term, like the process, is their own invention. The attitude assumed by the meeting with regard to the process in question may be described as one of appreciative reserve—the appreciation being for the authors' ingenuity, and the thoroughness with which they have worked out their idea; and the reserve being in respect to the efficacy claimed for the process as a solution of the naphthalene difficulty. Mr. F. D. Marshall's paper, which followed, was, by common consent, *the* paper of the meeting. It described, with a charm which is never absent from the contributions to technical literature of this most original of gas engineers, what will probably prove to be the best and most economical coal handling and coal storing plant in Europe. Thursday afternoon was occupied first with the reading and discussion of Mr. Livesey's paper on the theme which he has made his own—the conversion of the wage-earner in gas-works into a partner; and, secondly, with Mr. Salomons' paper on "The New Amsterdam Gas-Works." We shall find another opportunity to discuss these matters.

On Friday, a steamboat trip was made down the river—stopping at Wapping to inspect the local station of the Hydraulic Power Company, and at Rotherhithe to see the operation of coaling a gas-works from barges by means of grab-cranes. The end of the journey was Millwall; some time being occupied in inspecting the plant and works in progress at the Thames Iron-Works. Returning to Greenwich, the party was entertained by the President to lunch at the historic "Ship;" leaving for London before dusk. This ended a very pleasant and profitable meeting.

REPORT OF PROCEEDINGS.

The General Meeting of the Institution was held last Wednesday and Thursday, at the Institution of Civil Engineers, Great George Street, Westminster.

Mr. WILLIAM FOULIS, the retiring President, occupied the chair at the commencement of the proceedings.

ANNUAL REPORT AND ACCOUNTS.

The PRESIDENT proposed, and Mr. B. W. SMITH (Smethwick) seconded, the adoption of the report and accounts, which, having been circulated among the members, were taken as read.

The resolution was carried.

ADDITIONS TO THE ROLL.

Mr. J. TYSOE handed in the ballot-list of members as reported on by the Scrutineers.

MEMBERS.

Birkett, R., Gas-Works, Kensal Green.
Carpenter, S., Gas-Works, Dorking.

Drory, E., Gas-Works, Berlin.
Fletcher, P. H., Gas-Works, Evesham.
Glover, T., Gas-Works, West Bromwich.
Hack, T. H., Gas-Works, Sheffield.
Harris, F. M., Gas-Works, Barry.
Jones, H. E., Gas-Works, Stepney, E.
Morland, T. O., Gas-Works, North Sydney, N.S.W.
Peacock, B. H., Mortlake, Sydney, N.S.W.
Ramsden, F. L., Gas-Works, Burton-on-Trent.
Randall, W. B., Gas-Works, Waltham Cross.
Ray, W., Gas-Works, Adelaide.
Shoubridge, S. Y., Gas-Works, Salford.
Thompson, R. O., Gas-Works, Melbourne.

ASSOCIATES.

Gandon, H., Lower Sydenham.
Lewis, G. P., Lower Sydenham.
M'Minn, H. N., Kensal Green.
Thomas, C. W., Shanghai.

The PRESIDENT said the whole of the members had been elected. He had now to introduce to the meeting—a duty which was scarcely necessary—their future President, Mr. Corbet Woodall. He need say no more than express the confidence he was sure they all felt that the Institution under Mr. Woodall's care and guidance would flourish as well, at all events, as it had done in past years, if not better in some respects.

Mr. WOODALL then took the chair.

THANKS TO THE PAST PRESIDENT.

Mr. GEORGE LIVESEY, before Mr. Woodall rose to address the meeting, moved a hearty vote of thanks to the retiring President. Mr. Foulis had worthily occupied the leading position among the gas engineers of the Kingdom during the last twelve months—a position to which he was clearly entitled by his high character and great abilities. He had done a great deal not merely for the Institution, but for the gas industry generally, since he had been connected with them; and they all felt that it was a great honour he should have been their President.

Mr. A. COLSON (Leicester) seconded the vote. He said he could endorse all Mr. Livesey had said; and as one of those present at the Glasgow meeting last autumn, he begged to express, on behalf of the members, their sense of the great efforts Mr. Foulis had made to ensure a most interesting and successful gathering.

The PRESIDENT, in putting the resolution to the meeting, said that while mention had been made of the valuable, instructive, and pleasant meeting they had at Glasgow, they all knew that Mr. Foulis's services during the year were of a much more multifarious character than simply the organizing of the pleasant trip they so much enjoyed. They were all grateful to Mr. Foulis for the attention he had at all times given to the work of the Institution.

The resolution was passed amid applause.

Mr. FOULIS thanked the meeting very sincerely for their kind recognition of anything he had been able to do for the Institution. If he had forwarded its interests in any way whatever, he felt entirely rewarded for any trouble he might have taken.

The PRESIDENT then read the following

INAUGURAL ADDRESS.

To those who, perforce, recognize that the greater part of their working life is behind them, it is natural to discover and welcome occasions for retrospect. Indulging this tendency, it occurred to me—I think naturally—when considering what to say in this address, that I should look back over the interval that has elapsed since it was last my pleasure to preside over a technical society representing the British gas industry; and glancing briefly at the changes I have noted in the principles and practice governing the conduct of gas undertakings, deduce from them, if possible, some suggestions for the future. This was, I say, natural to me; but it surprised me to find, when too late, that much the same sentiment had influenced my esteemed predecessor, Mr. Foulis—without, I think, the same justification—when he addressed you last year. I have one very qualified advantage over him, however, in that it is not nine, but nineteen, years which have elapsed since I occupied a corresponding place to this.

Nineteen years, I am reminded in many ways, is a large slice out of the professional experience of a man, although it may not be a great span in the history of a national industry. "Art is long, life is short;" and perhaps the most that the busiest and happiest of us can hope for in a survey of his past, is that the glance may not be upward as well as backward. This is emphatically not the case with the British gas industry. I look back to the period of my presidency of the British Association of Gas Managers in 1878; and although, of course, the main lines of gas engineering practice are of the same origin and aim as they were in those days, I am impressed with the range and diversity of the later growth and development through which those lines now lie.

In the manufacture of gas, and in almost every corner, so to speak, of a modern gas-works, what nineteen years ago was done wholly by manual labour, is now effected, to considerably greater advantage, by mechanical means; and types of apparatus that had been sanctified by the approval of generations of designers and workers, have been replaced by quite different appliances. In order that this might be, it was necessary that an even greater and more far-reaching change should be made in the substitution of more exact knowledge, of clearer reasoning from more careful experimental data, for the old "gas-works routine," familiarity with which was, and to some extent still is, esteemed a complete equipment for a gas-works manager. I would not be understood as speaking lightly of routine as a guide to good working in gas making, as in almost everything else. We must speak well of the bridge which carries us safely over; and it is certain that gas-works routine has all along been the mainstay of the gas industry through the chances and changes which have left their mark on its actual condition.

Alongside, however, and over and above the routine work of keeping gasholders off the ground and paying dividends, there has been during these years with which I am dealing an active living spirit of investigation, study, criticism, and innovation which has insensibly changed the face of most of our gas-works. It is difficult, to the verge of impossibility, to point to a particular year as witnessing a certain advance, or to ascribe to an individual the credit due to whoever gets more light, heat, or power out of a pound of coal than was obtained before. All that we can say is that, looking back upon the British gas industry through the sufficiently long perspective of nineteen years, it can be perceived to be a different business from what it was at that period in my own experience. Nor are these changes, these new features, mere details or superficial aspects of what might be the same thing essentially at bottom.

Gas supply is a very much bigger business than it was in 1878. It is not merely that twice the weight of coal has to be carbonized, and that double the quantity of gas has to be provided for the public demands. This is the basis of the problem of modern gas management; but its ramifications are far reaching. Not only has the modern gas engineer to do more, but much that he has to do would not have been regarded as gas engineering at all by his predecessors. These had their own difficulties; and be it far from me to belittle or to disparage the qualities which went to overcome them. But my point is that the gas engineering of the present day has more sides, as well as a broader basis than formerly.

It is a commonplace to say that the gas industry has been stirred to its depths, and awakened to keener life and greater adaptability, by the competition of the electric light. I cannot directly negative this view; but it is only partially true. I take it that the remarkable modern expansion of the gas business is rightly attributable to the large place which the industry holds in the world. There has been so much effort put forth in every direction, for the improvement of every human interest, that it would have been strange indeed if the gas industry had not felt something of the movement. Where so many millions of money are invested, and so many men are employed, there will always be attraction and scope for the ingenious, if sometimes pestilent, persons who will not let things remain as they were in the old time before them.

I am laying emphasis upon this broad view of the course of the remarkable modern expansion of the gas industry, for the reason that it is one which we who are in the centre of the movement are seldom able to take. It is but rarely that a practising gas engineer, whose care and attention are necessarily occupied day by day with one pressing detail after another, can take up a position of the necessary degree of detachment to enable him to look round and realize for a moment where he stands—how far he has travelled, and whither his course is tending. Let me, therefore, take this opportunity of recording my opinion that the spirit of a

progressive age has been working inside as well as outside the gas industry, forwarding it in correspondence with the increased demands of the community. It is the more important to bring out this truth of the unimpaired vitality of our industry, which has enabled it to correspond so perfectly with its environment, as some of our good friends the electricians have been trying for many years to persuade the world that our business is moribund. We, of course, know better. But this is not sufficient; and it is expedient that the rest of the world should be equally informed of the truth. There is no reason to complain of the view of the gas industry taken by those of the public who have money to invest. Never has gas property stood so high in the estimation of capitalists as during the past year. What we want to attract into our industry, however, is not only money, but intellect, ingenuity, energy, and enterprise. We want to convince the world at large that, so far from the industry being on its last legs, it is only at the commencement of a wider career of usefulness; and that in a field of such magnitude and prospects, there is room for all that science and invention can bring into it.

I cannot speak with the knowledge which many of our members now possess of the possibilities of further economies in the production and supply of electric light. What I do know, is that in this respect our older industry retains the characteristics of youth. In the methods of manufacture, in the materials used, and in the products and bye-products resulting from the operations of manufacture and purification, the field open seems broader now than at any previous time, and should be as attractive as ever to well-equipped labourers. Nineteen years ago gas making, as I have already observed, was mainly hand work. To this extent it was more a matter of routine, discipline, and hard labour, than a problem for the application of mechanical science. The same period saw the birth of the electric lighting industry, which issued, a thing of delicacy and beauty, from the laboratory. No two industries could have had origins more widely different. Gas making was for the half-naked man with the shovel; electricity was the product of the study, elegantly dressed by the mathematical instrument maker.

In my address in 1878, I described, not inappreciatively, the work of M. Jablochkoff, which was then the great novelty in street lighting. The incandescent lamp had not been invented; and I was perforce obliged to confine my criticism of the new system of lighting to the only illustration of it I could find. It is rather trying to reperuse, in the light of so much subsequent experience, what one has said on such a subject so long ago; but having done so, I find (to my immense relief) that, if allowance is made for the disturbing inventions of those to whom the incandescent electric lamp and its service are due, I was not far wrong in my vaticinations. I formed the opinion then that the electric light would not do more than "touch the fringe of our business." Perhaps I may be pardoned for repeating this sober judgment of 1878, for the sake of contrasting it with the "wild and whirling words" of electrical prophets at the time and since. I also formed the opinion at the same time—which is even now only subject to slight modification—that electric light required two-and-a-half times more capital than was needed to do the same amount of work by gas.

To turn, however, from these personal reminiscences to the main argument. These two industries, so different in 1878, are now very near one another at many points. This is due to the influence of mechanical science, which has been brought to bear upon both. The man with the shovel and the mathematical instrument maker have retired into the background; and the mechanical engineer reigns in their stead. In neither industry has practical development during the past nineteen years taken quite the turn expected. The physicist has not enabled us to obtain electricity direct from carbon, or to do without conductors. The chemist has not told us how to radically change the old methods of carbonization, nor how to purify gas continuously in closed vessels. Electricity supply stations, have, however, become steam-power factories; and gas-works have been largely remodelled as establishments where heavy materials have to be handled as expeditiously and cheaply as possible by mechanical means.

These considerations lead me to two conclusions, which I must develop a little, at the risk of trespassing on your indulgence. I wish to plead for a closer union of the industries of gas and electricity supply, in the public interest; and for the fusion of the studies of gas and electrical engineering, in the interest of our profession. It should hardly be necessary to enforce the point; but it is as well to make it clear that my motive in advocating the closer union of gas and electric lighting is not that of safeguarding the interests of the suppliers of gas as monopolists of the lighting trade. There was, undoubtedly, a time when some people thought that gas companies would be well advised to take up electric lighting as a second string for their financial bow. This was done, in point of fact, in many places—notably in the United States. Holding, as I have done from the first, and still hold, that electric lighting will not do more than affect the fringe of the gas business, it is obvious that there would be a contradiction involved in my commending it to gas companies for the sake simply of its income-earning capabilities.

Moreover, it is equally obvious that even the fringe of the artificial lighting trade, in such centres as London and the other great aggregations of population at home and abroad, will be enough to fully engage the energies of an independent organization just as the normal annual growth of the Metropolitan gas output would be quite large enough to furnish work for a new undertaking on a scale amply sufficient to ensure economical production. Without pretending to define the conditions under which independent electric lighting supply may be desirable, I am sure that a very much larger number of cases exist of localities where a limited, but legitimate, demand for public electric lighting must remain unsatisfied unless the service is combined with the local gas supply. This is the true meaning of those numerous Electric Lighting Orders being allowed to lapse, by reason of the local authorities who obtained them—sometimes at considerable expense—not being able to satisfy themselves that they could be carried into effect without loss; and, naturally, the same influences that deter local authorities from carrying out their Orders, operate to discourage private undertakers from taking over the responsibility. Here, I do not hesitate to say, the proper solution of the difficulty is to be found in an agreement between the local authority and the gas company, whereby the latter would engage to meet the requirements of the district in the matter of electric lighting—not only, or chiefly, for the sake of direct profit to be made out of it, but in recognition of the fact that they are alone able to do the work without loss. Electric lighting has done gas a service by removing to a large extent the reproach of monopolists from us; but sensible people are less likely now than formerly to be frightened by a phrase, when it is seen how efficiently the interests of the public can be safeguarded by regulation.

Gas companies have shown of late years, by their introduction of prepayment meters and free fittings, that they are able and willing to institute fresh developments of their business which could not possibly pay if they stood alone; and there is nothing but red tape, and a little strangeness in the idea, to prevent them doing as much in a different way for the wealthy and more fashionable element in their districts. It is quite unnecessary here to show how easily this service could be undertaken by many gas companies. This is not the place for discussing in detail questions of whether, assuming the business undertaken, electricity can be best generated at the gas-works, or whether gas-engines installed in sub-stations are to be preferred. Every case must be treated on its merits; my only care being for a better and more general recognition of the principle that the relations of gas companies, local authorities, and the public in this regard might well be modified with advantage to each and all.

This brings me to my second point, which is no more than a plea for the inclusion of electric engineering among the studies of the rising generation of gas managers' assistants, who will in due time become gas engineers and managers themselves. I approach this part of my case with diffidence; knowing as I do how much easier it is to give offence than to succeed in making one's meaning quite clear when one has a complaint to utter. I feel strongly, however, an obligation to speak out on this matter. The question is: Are we attracting into the ranks of our profession the right kind of student—speaking, that is, with reference to what is actually going on in regard to electric engineering? I do not think so.

I am aware, of course, that the industry has within its junior ranks a number of very excellent and promising young men; and I am quite sure that the members of this

Institution are eminently capable of bringing such pupils and assistants on in the way in which they should go. But what I want to submit to your attention is the circumstance that, as indicated by the returns of the City and Guilds of London Institute—which might be supplemented by inquiry of any leading electrical engineer—the attractiveness of the electrical profession for well-educated, well brought-up youths is very great. There is no possibility of a career in it for one-quarter of those who are not only desirous of entering it, but are also perfectly qualified to make a good use of whatever opportunities of advancing themselves may come in their way. Speaking quite generally, these are a different order of youths from those who are attracted into gas-works; and I must confess that I am jealous of our friends the electricians in this respect. Depend upon it that, unless there is a good flow of capable men into gas engineering, the status of our profession will not be maintained. One hears from time to time of the miserliness of gas managers' employers; and I fully admit that the salaries attached to too many managerships are scandalously insufficient. At the same time, the electricians are in no better case. The pecuniary inducements they can offer are by no means rich; but yet the very pick of the budding ingenuity of the nation is at their command. We want some of these young fellows too; and the way to get them will be to make room for them in our works and offices. They will come to us as readily as they will go to electric lighting stations.

I think that in gas engineers' offices, and in every considerable gas-works, there ought to be a capable assistant with a knowledge of electrical science. Common prudence dictates this. We, as gas engineers, have already so much to do with electricians, and are fated to have so much more when electric traction and other applications have their full development, that we cannot afford to have a mere bowing acquaintance with their speciality. Let us try to realize what the responsibilities of the gas engineer in the not distant future are likely to be, and we shall perceive that the best present training cannot be too good for those on whose shoulders the burden will fall. This solicitude for the educational basis of our common profession is no new thought with me. I mentioned the subject in my address in 1878; and my sense of what is wanting in this regard has not been lulled by more recent observation. Our successors in the race must develop, in order to correspond with their larger responsibilities and their more varied cares. Those who cannot or will not do this, will be left stranded with ill-paid posts under grumbling employers.

The best way to improve the circumstances and emoluments of any profession is to begin by improving the men who engage in it. This must be done from within, before there is any apparent demand in the employment market for improved quality in the aspirants for appointments. My plea for greater attention to the scientific and technical education of our young men may well be enforced from the point of view of the position which the British gas industry has held, and is to hold, internationally. I am satisfied that there is, on the average, among engineering students in England less thoroughness in the acquisition of scientific knowledge than is the case in some other countries. The British Government takes less interest in the adequate education of its citizens than do the Governments of the Continent. The higher technical education is far more costly to the student in England than it is, for instance, in Germany, and is consequently available to a relatively smaller number. But what I think we too often lack—what, if we possessed it, would help to counteract many disadvantages—is the disposition to study, and to follow up investigations for the sake of acquiring thorough mastery; not to be satisfied with one step forward, but to try and make every step a help to further progress.

The laboratories of gas-works may well be made more than they are at present the home of research and independent investigation, so that room could be found for men of active intelligence, whose work would result in great gain to the industry, and who would be trained at the early period in life when such training is possible. To the young men themselves, I would say: Let good men, thoroughly furnished, be ready, and place and pay will be found for them. This proceeds from the very nature of the case of an expanding and developing industry. If the gas industry were a failing enterprise, or even an industry which had attained its maximum development, the case would be otherwise. We are face to face with a specific illustration of the simple truth that, whether with men or things, it is supply that creates the demand; success is fairly certain to those who perceive and apply this.

I have been beguiled so far by this subject, that little time is left me in which even to catalogue the leading developments of our industry which the past nineteen years have witnessed. Among these, alterations in the systems of heating and of operating retorts occupy a chief place. I need not refer to the saving of labour and fuel, and to the increased duration of the retorts themselves, which have followed upon the adoption of gaseous firing, save to note that it has been an important factor in the economies which have helped to so materially reduce the price of gas.

The introduction of the system of inclined retorts is an innovation heartily welcomed, and which is having, and will certainly continue to have, a wide acceptance. It is not necessary I should remind practical gas makers that, while there are many and great conveniences attaching to this system, its possibilities of economy are limited. By its adoption, the proportionate number of workmen employed is greatly reduced as compared with hand labour, and is less even that what is required with an efficient system of mechanical stoking. It is possible, also, to carbonize a larger quantity of coal on the same ground area than with the system still generally prevailing. Further, as has been shown in several cases in England—notably at Messrs. Hardman's works at Harecastle—and also in an admirable model which was shown at the last meeting of this Institution, it is possible to reduce the cost of houses enclosing inclined retorts considerably below their present cost for a given output. The model I refer to was prepared by Mr. Edward Drory, then of Vienna and now of Berlin, whom we have gladly welcomed to-day as a member. He has promised to prepare a paper for our next meeting dealing with the relative cost of building and operating inclined and horizontal retorts (whether worked by hand or machine) and their efficiency; and his experience will make that contribution of peculiar value.

Bearing in mind to what a low cost the labour in the retort-house has been reduced by the work of our Past-President Mr. Foulis, by Mr. West, and others, the margin for further saving is but small, and would not alone justify large expenditure in reconstruction of works. Where, however, new works or large extensions are required, it will be found, I think, increasingly that this most mechanical and attractive system proves its claim to preference. A very grave question has been raised by one important company, in whose experience it was found that the illuminating value of the gas made in inclined retorts was inferior to that from horizontals; the quantity not being larger. I will not stay to consider possible explanations of such an experience; but may express a hope that when we next meet—if not before—authoritative statistics will be forthcoming as to the facts.

We shall probably agree that the most interesting development of our industry in recent years has been the introduction of carburetted water gas. This process of gas making has received so much attention here, that I have no intention of dealing with it at any length. By furnishing an economical alternative for enriching ordinary coal gas, and by widening the field from which we are at liberty to purchase coal, it has already conferred very large benefit, not only upon those who have adopted it, but also upon those who have not. It furnishes, in my experience, by far the most economical method of enriching coal gas—indeed, in very many cases an enriching gas of 22 candles can be made at less cost than the coal gas of, say, 15 candles which it is desired to enrich. Especially is this experienced where freight is an important element in the cost of material. Having regard to the short period during which the maximum demand upon a gas company's plant continues, it is well to have a plant which can be put into action for a short time, and let down with the minimum of injury. It is also clearly of advantage that such plant shall be erected at the least possible cost. These conditions are met by water gas. Again, the sudden large demands which come at erratic intervals, and are so difficult to provide against by storage, are met by apparatus which can be brought into use so promptly, and which requires so small a staff of men. The experience of the past five years seems to indicate that very shortly most gas undertakings of moderate size will have installed a carburetted water-gas

plant—and that, in some degree, independent of consideration of the cost of the product.

Within the last few months, there has been a considerable agitation in various parts of the country on account of the assumed danger attaching to the large percentage of carbonic oxide in water gas. It is almost certain that in the belief of most of those who honestly protest against water gas on this ground, the dangerous component is liberated in the process of burning. Coal gas, we have all had occasion to know, is not, when inhaled, as pleasant and health-giving as a fresh breeze from the sea; it can be, and often has been, fatal to those who have imbibed too much of it. But gas is made to burn, and not to breathe; and fortunately, whether made from coal only, or mixed with carburetted water gas, or when the latter is used alone, it has an odour which promptly indicates its presence. Because of this odour, escaping gas is apparent long before the atmosphere of a room is in a condition at all injurious to health; and the cause can be ascertained and remedied. I suffer no alarm because of any danger attaching to the supply of electric light in my house; yet there are dangers attending careless workmanship with electric wiring which are, I think, greater far than those attaching to gas-fitting. Care must be taken in both cases that work is well done.

I heard something while in the United States in 1889 on this question of carbonic oxide from coal gas makers averse to changing the process they had in use. Yet within a very few years, all of them had adopted carburetted water gas wholly or in part; and I believe no fatal case of poisoning by gas has been investigated where the result was traceable to carbonic oxide, or where the catastrophe would not have been the same whatever the character of the gas.

I am tempted to make one further reference to my observations in 1878, because I then ventured on prophecy that in the (then) future gas would be used for "driving a tramway car." It is very gratifying to notice the increasingly successful application of gas to this purpose, which promises to open up a wide demand. In Dessau, and equally successfully in Blackpool, a tramway service is being conducted efficiently and very economically with gas as the sole power. In my opinion, founded upon careful observation, this system is the most economical available for suburban traffic and long distance journeys when the road gradients are fairly easy; and gas companies will do well to facilitate its adoption as far as they are able.

These, together with first regenerator and then incandescent burners, prepayment meters, the enormous development of the use of gas for heating, the application of wrought iron and steel to the construction of gasholder guide-framing, the suppression of guide-framing altogether or the use of ropes in its place, are some further instances of the activity which has characterized the period under review. I feel some confidence that, nineteen years hence, the record will be at least as good, and that those who are present at the meeting of this Institution in, say, 1916 will be able still to feel that the end of improvement is not yet.

And now I have only one thing more to say. As I have dealt broadly with the material and with the professional aspects of the gas industry with the sole intent of indicating, by reference to the past and observations of the present, what I think will be the requirements of the future, so now I desire to offer a few words, very diffidently, respecting what I may call the sociology of the industry. My own long and intimate acquaintance with gas workers was consistently pleasant. The Company whom I served was desirous of acting the part of a good master; and it was always my inclination to help to realize this aim. This was the epoch already referred to, of the man with the shovel in gas manufacture; and I am old-fashioned enough to regret his steady displacement. So long as he responded to the esteem I entertained for him, I should have been loth indeed to help disestablish him. Whether for good or evil, however, times have changed with the gas worker, as with the rest of the world. The progress of social development is from status to contract; and I have come to see that there was no little of the feudal spirit in the old system of factory organization—when the master had all the say, and the workpeople were supposed to be content so long as they held their peace. Unpleasant as it may be to confess it, I think we must admit that the newly-found desire of the workman to have a part in the ordering of his work, is an illustration of the way of progress just indicated. It is therefore to be reckoned with. Naturally, the first effects of the working of such an influence are rebellions, revolts, industrial wars. These disturbances, however, are incidental and transitory.

I am persuaded there is no returning to the old ways of feudal dependence; and that the easy and the right way to a resettlement of our labour conditions, will be best sought along the line which Mr. George Livesey has indicated by practical illustration, as well as by precept. I am not specially attracted by the name of profit-sharing, which does not convey to my mind the idea of a panacea for all industrial ills. I do believe, nevertheless, in demonstrating to the working-man, by any and every means that may serve this purpose, the cardinal truth that capital is his best friend instead of, as the Socialists vainly teach, his worst enemy; and I hold that whatever is a realization of this truth, is a question of right and not of favour.

Hence I desire to follow Mr. Livesey's lead, so far as to give to workmen, as we have in so many cases already given to officers, a direct interest in the success of the work by which they live. I would do this, not only by allocating to them (in addition to their ordinary wages) a share—fluctuating with the success of the undertaking—of the gains they can largely influence, but also by giving them, through their elected representatives, a consultative position with regard to the direction of the undertaking. We shall be the better for the workmen's intelligent co-operation as freemen in furthering the prosperity of our common employment. To effect this, we must enter into a contract with them; and the clearer it is made that the contract terms are of advantage to both parties, the safer will the engagement be.

I need not say that, in so speaking, I am expressing simply an individual opinion. We are to hear from Mr. Livesey—not for the first time—at this meeting his views and experience upon this important question. Whether or not we agree with his conclusions, we all admire his courage, and congratulate him upon the success of his efforts; and I think we may count it a distinction for this Institution that one of its members should have brought to such completeness a scheme so successful in the special case where he has applied it, and so full, as I think, of promise for the future harmonious relations of those engaged in every grade of our industry.

Mr. William King (Liverpool) said he was sure, before the meeting proceeded to the other business of the day, the members would wish to pass a hearty vote of thanks to the President for his address. They expected much from Mr. Woodall; and they had had the great advantage of listening to an address from one who had not been confined to mere official duties. They had heard from an outsider, so to speak—from one who was relieved from daily routine and was able to take an independent view of the important industry with which they were connected. Expecting much, they had not been disappointed. He (Mr. King) asked them to join in a hearty vote of thanks to Mr. Woodall for his able address, in which there were many points to afford food for reflection; and if they only gave thought to them much good could not fail to result.

Mr. A. M'Minn (Kensal Green) seconded.

The President, in responding, expressed himself as much obliged for the way in which they had received the vote. His address was not quite along the lines which the Institution had a right to expect its President to follow; but the feeling of partial detachment to which Mr. King had alluded, had impelled him into the particular line he had taken. He hoped it would be seen, on consideration of what he had said, that there was room for material improvement in the preparation of the men who had to carry on an industry which had so much promise of enormous improvement and development. By means of some institution of a national character, they might be able to take a share in bringing about this development.

Standards of Light.

The President asked Mr. Hunt to bring up the report of the Committee upon "Standards of Light."

Mr. Hunt said he had to ask the indulgence of the meeting. Although the Committee appointed last year had been engaged in many experiments almost ever since, and it had been expected that the programme drawn up would be finally accepted and the report agreed upon it, was found impossible to do so in time for the meeting, at

the last moment, on account of the distance separating some of the members of the Committee. He had therefore to ask the meeting to agree to a postponement of the report, promising that it should be submitted at the earliest possible moment.

The PRESIDENT said they must perforce accept the proposal; there seemed no help for it.

READING OF PAPERS.

The reading of papers was then commenced. They were taken in the following order:—

Wednesday.—(1) "The Luminosity of Flame." By Professor A. SMITHELLS, B.Sc. (2) "Notes on Cyanogen as a Gas-Works Residual." By G. P. LEWIS.

Thursday.—(3) "The Carburation of Coal Gas." By C. E. and C. F. BOTLEY. (4) "Modern Machinery for Handling and Storing Coal." By F. D. MARSHALL. (5) "Another Step in Promoting the Union of Capital and Labour." By G. LIVESEY. (6) "The Amsterdam Gas-Works." By H. SALOMONS."

The papers read on the first day, with a report of the discussions thereon, are given in another part of the "JOURNAL;" the remainder of the technical portion of the proceedings being held over for a subsequent issue.

At the close of the discussions on Thursday afternoon, the general business was resumed.

AN HONORARY MEMBER.

The PRESIDENT remarked that there was still some business to transact. In the first place, he had to bring forward a proposition of the Council that they should avail themselves of the power given by the Articles of Association of electing honorary members, who should be persons noted for their scientific attainments, coupled with experience in pursuits connected with gas manufacture. It had been suggested that they should now commence the list of honorary members by offering that position to Dr. Auer von Welsbach. They all appreciated the great services he had rendered to the gas industry; and they felt that it was not by a fortunate accident, but as the result of long years of work, that he made his discovery with regard to incandescent gas-burners. He (the President) had much pleasure in proposing the election of Dr. Welsbach as an honorary member of the Institution.

Mr. FOULIS seconded the motion; and it was at once carried unanimously.

THE SCRUTINEERS.

The PRESIDENT moved the re-election of Messrs. A. E. Broadberry, T. S. Lacey, and J. Tysoe, as Scrutineers.

Mr. T. MAY (Richmond) seconded the motion, which was carried.

VOTES OF THANKS.

The PRESIDENT then moved a vote of thanks to the authors of the papers read at the meeting. He said he believed they had been fully up to the average of those submitted in past years; and if one or two had not lent themselves to lengthened discussion, this did not arise from any defects in the papers. They had covered a wide range of subjects, and fully bore out a remark made the preceding day, that the basis of work for the Institution was broadening, and promised to become still wider.

Mr. FOULIS, in seconding the motion, pointed out how important it was to the success of the Institution that suitable papers should be provided for the annual meetings; and he expressed the hope that all the members would bear this in mind.

The motion was carried unanimously.

The PRESIDENT next moved a vote of thanks to Mr. Magnus Ohren, the Hon. Auditor, whom he hoped they would long be able to retain in this capacity, not only because it was very pleasant to see him among them, but because he had special qualifications for the work, and did it most conscientiously.

Mr. R. O. PATERSON (Cheltenham) seconded the motion; and it was unanimously agreed to.

Mr. J. T. JOLLIFFE (Ipswich) moved that the best thanks of the meeting be given to the Council of the Institution, for their services during the past year.

Mr. T. HOLGATE (Halifax) seconded the motion, which was at once carried unanimously.

Mr. FOULIS shortly responded. He said he had not been able to do much himself, living as he did so far from the centre of operations; but he was sure all his colleagues would feel amply rewarded for their labours by finding that their services were appreciated by the members.

The PRESIDENT proposed a vote of thanks to the Council of the Institution of Civil Engineers for kindly allowing the use of their building for the meeting—a privilege which, he said, everyone must appreciate.

Mr. C. C. CARPENTER (Vauxhall), in seconding the motion, expressed the hope that the same privilege would be accorded to the Institution in future years.

The motion was carried.

Mr. J. W. HELPS (Croydon) moved that the best thanks of the meeting be given to the President for his able conduct in the chair. He said that, knowing Mr. Woodall as he did, he anticipated with absolute confidence that the meeting would be a great success; and this confidence must have been shared by everybody. His great courtesy, combined with admirable firmness, must have given general satisfaction.

Mr. F. D. MARSHALL (Copenhagen) seconded the motion; and it was carried by acclamation.

The PRESIDENT, in responding, said there was always greater satisfaction in putting off one's armour, in a work of this kind, than in putting it on; and though he came to the chair with very little fear as to the manner in which the meeting would pass off, it was still a source of great satisfaction to feel, as he did, that it had been a pleasant and profitable gathering. He was not aware that much firmness had been required, for the kind way in which the members always supported the President made his work very light. He added that he could not allow the meeting to separate without passing a vote of thanks to the Secretary (Mr. Thomas Cole), for the manner in which he had performed his duties.

This having been carried,

Mr. COLE briefly responded, and the proceedings then terminated.

STOKING MACHINERY AT VAUXHALL.

At the close of the discussion on Mr. Lewis's paper,

The PRESIDENT informed the members that, at his works at Vauxhall, Mr. Carpenter had one or two systems of operating machines mechanically for the charging and discharging of retorts, including one where the apparatus carried its own crane, and lifted the coal from the stage. If any members cared to visit the works, Mr. Carpenter would be very glad to receive them.

Mr. CARPENTER said of the two systems of charging and drawing retorts that had been erected at Vauxhall at the present time, only one was working. That was the Foulis-Arrol machinery; and it was a modification of the plant mentioned in the paper he had the honour of reading to the members two or three years ago.* It was in operation in part of the retort-house, and members might be pleased to see it. The total producing capacity of the house was now 3½ million cubic feet per day. It might probably be remembered that the scope of the paper was to draw attention to the novel method of storing the coal. Instead of it being stored in overhead hoppers, continuous hoppers were made along each side of the retort-house. The coal storage by means of these hoppers was 480 tons; so that storage was provided for 1½ days' working. The charging-machines had regulators attached to them; and they fed themselves with coal as they ran along the stage.

PAPERS AND DISCUSSIONS.

THE LUMINOSITY OF FLAME.

By Professor SMITHELLS.

The author is here to-day in response to an invitation which he had the honour to receive from the Council of this Institution; and he trusts he will be doing what is desired of him if he attempts to define the present state of our knowledge concerning part of a large subject which he has been engaged in studying during the past few years. The problem of the luminosity of hydrocarbon flames has received much attention; and it may seem remarkable that it should still be the focus of so much experiment and controversy. But the author thinks there is a very simple explanation—the subject presents quite special difficulties.

The chief difficulties may be enumerated as follows:—

1.—There are an enormous number of compounds of

* See "JOURNAL," Vol. LXI., p. 931.

hydrogen and carbon; and no adequate means of identifying them individually in mixtures of even moderate complexity.

2.—A single hydrocarbon subjected to heat may produce a complex mixture of other hydrocarbons. The nature of this mixture may vary enormously with the temperature; and the conditions of equilibrium at high temperatures cannot be traced more than a very small way.

3.—The gases constituting a flame do not form a homogeneous mixture, but are part of a stream, which, owing to the progressive action of heat oxidation, exhibits an alteration in composition from point to point. Experiments with the combustible gas in a closed vessel, with a fixed amount of air at a fixed temperature, only reproduce the conditions existing in an indefinitely small region of an actual flame.

4.—The temperature conditions existing within a flame are exceedingly complex. While in a gas raised by external heating to any temperature we are dealing with a collection of molecules which are no doubt moving with infinite variety of speed, it is nevertheless true that the number which move at twice the average speed is not more than 2 per cent.; while those moving at four times the average speed, is less than one-millionth of the whole. In flames we have something quite different from this. In a large portion of the interior of a flame, we have a range of temperature insufficient to cause a thin wire to glow; while by a movement of a few millimetres, we pass to a region of temperature beyond the melting-point of platinum. Here, again, experiments on the effect of heat on hydrocarbons at one uniform temperature in closed vessels reproduce only the conditions existing over an indefinitely small region of a flame.

5.—There is great difficulty in ascertaining what gases exist at any particular region of a flame, owing to the fact that the conditions of equilibrium between hydrogen, carbon, and hydrocarbons are mobile—that is to say, a change induced by a rise of temperature may be reversed by a reduction of temperature. This is characteristic of all chemical actions which are of the nature of dissociation. The only means of catching flame gases as it were "on the hop" is that used by Deville, in which a portion of the gases is withdrawn and cooled so quickly that a reversal of the action has not time to complete itself. In this way, Deville succeeded in withdrawing uncombined hydrogen and oxygen from what may be called the burning part of a hydrogen flame. The gases at the moment of withdrawal were far above the temperature of ignition of hydrogen. In the flame they were in the dissociated state. If withdrawn and cooled slowly, they would have formed steam. But by sudden cooling, the gases were reduced below the temperature at which combination could take place before the separated atoms had all had time to meet with their partners. This method of studying the effect of heat on hydrocarbons has never been carried out, as far as the author is aware, except by Professors Liveing and Dewar, who used it to demonstrate the existence of acetylene in the blowpipe flame.

6.—Little is known concerning the vaporization of carbon. The boiling-point of carbon has been computed to be 3500°; but this is at variance with important facts. The latent heat of vaporization of carbon is not known, so that the thermal effect of condensation of solid carbon from gaseous hydrocarbons cannot be estimated.

7.—The last special difficulty that I will name is, perhaps, moral and intellectual, rather than practical. The molecular physics involved in flame problems is exceedingly complicated; and what may at first sight seem an easily interpretable phenomenon, will often prove to be capable of interpretation in several different ways. It is, therefore, often very difficult to avoid unconsciously accepting the particular interpretation that is favourable to a particular hypothesis, or unfavourable to it, according to whether we are on other grounds inclined to accept or reject the hypothesis. The author is quite willing to confess himself continually in this danger, and to find the greatest difficulty in guarding against it.

The subject of the luminosity of hydrocarbon flames really involves the whole question of the chemistry of flame. The author is compelled to omit the full discussion of many points that, if time had permitted, he would gladly have dwelt upon. The particular part of the glow of a hydrocarbon flame in which practical men are specially interested, is conditional upon the existence in the flame of a substance which is condensable in the form of soot; and we want to know (1) what this substance is; (2) what state it assumes in the flame; (3) how it is separated in the flame; and (4) to what its bright glow is due.

(1) *The Chemical Character of Soot.*—It is well known that soot is almost wholly composed of carbon. It contains a certain amount of semi-solid matter, which is generally admitted to consist of hydrocarbons. When these hydrocarbons are removed by solvents, and the residual black solid, after strong heating, is analyzed, there is still found something like 1 part of hydrogen to 99 of carbon. A substance of this composition cannot be said to come into the category of recognized hydrocarbons. Berthelot apparently, however, considers the hydrogen to be chemically united with the carbon; for he believes that the progressive action of heat on hydrocarbons consists essentially in the banding together of molecules step by step with the elimination of hydrogen, so that in the end we should get carbon itself as a sort of limiting state. It is well known that we can, indeed, obtain this kind of action for a certain range of hydrocarbons. Berthelot merely supposes it to proceed beyond the point at which we can easily mark out the successive steps until, as stated, the proportion of hydrogen atoms to carbon atoms is vanishingly small.

(2) *The Physical State of Soot in Flames.*—Whatever be the chemical nature of soot, it is marked off from recognized hydrocarbons by its physical properties. There is no direct evidence that it ever exists in flames in the state of vapour; but there is much evidence to show that it is solid, even when glowing at its brightest. The author will not reproduce this evidence; but will merely remark that the optical test first used by Soret is considered to be absolutely conclusive on this subject. It is worth while to add that Soret's experiment also gives some indication of the size of these solid particles. They must be of the same order of magnitude as the particles of shellac, which cause the turbidity when a drop of shellac varnish is added to a large quantity of water. To indicate the smallness of these particles, it may be said that they are quite beyond the range of microscopic vision. To set a limit to their smallness, it may be further stated that the particles must be so large that their diameters are comparable with the wave-length of light. Lastly, the author will say that each particle probably contains a number of atoms to be numbered by hundreds of thousands. These facts have to be borne in mind. A neglect of them has led people at times to speak of the particles in a flame either as if they were so gross as to be comparable to finely powdered charcoal, or as if they were single atoms. One mistake is almost as bad as the other, and may lead to hopeless confusion.

Whether the bright glow of a flame is wholly associated with the black solid which contains 1 per cent. of hydrogen, or whether any of the glow effect is to be ascribed to it or other unknown hydrocarbons glowing with a white light in a state of vapour, is a question that the author will not discuss. It is well known that Dr. Frankland came to the conclusion, thirty years ago, that dense hydrocarbon vapours are the chief source of light in common flames. The author has recently discussed this view elsewhere, and criticized the train of reasoning that led to it. He will only here express the belief that, whether there are glowing hydrocarbon vapours or not, there is enough solid matter in the flame to account for all the light that is emitted. One cannot be absolutely certain on such a matter; and the author merely expresses the result of his own consideration of it.

(3) *The Mode in which Carbon is Set Free in Flames.*—Two totally different kinds of explanation have been given of the way in which carbon is set free in flames. One ascribes the process to the preferential burning of the hydrogen in the marginal region of the flame, where the hydrocarbon is mixed with insufficient oxygen for complete combustion. The other explanation ascribes the separation of carbon to the decomposition of unoxidized hydrocarbons within the flame by the sole action of heat. Like most other chemists of his generation, the author was brought up in the belief that preferential oxidation was the real cause. His first awakening came during experiments on non-luminous gas-flames of definite hydrocarbons. The apparatus which he used in the experiments is, he thinks, pretty well known; but in case there may be some present who have not seen it, it has been brought here for exhibition. When the author found that the gases withdrawn from the internal region of an ethylene air-flame contained a considerable

amount of free hydrogen, and an almost inappreciable quantity of unoxidized carbon, he thought he had made a discovery of considerable importance; but he soon found that it was but a re-discovery of facts which had been set forth at least four times previously at different dates, and on each occasion supposed to be new. The author trusts that it is not too much to hope that the writers of chemical books will ultimately be prevailed upon to admit an important piece of information which has so often knocked at their doors in vain. The author's experiments showed, beyond any possibility of doubt, that when a hydrocarbon is burned, as in the internal cone of a bunsen flame, with a restricted supply of oxygen, the flame gases after cooling contain much free hydrogen. This fact alone might be held not to prove that hydrogen exists free within the flame; for if it be supposed that steam and carbonic oxide are really the gases in the flame, then on cooling down these gases might react so as to form some carbon dioxide and free oxygen. The gas withdrawn from the flame could therefore, in its cooled state, not represent what actually existed therein. The author failed, however, to find any evidence in favour of this view; and he has not succeeded in discovering any other origin for the doctrine that the hydrogen of a hydrocarbon burns preferentially to the carbon, than the entirely gratuitous assumption that hydrogen has the greater affinity for oxygen. This assumption arises, he presumes, from the contrast which the mind is apt to make between the inflammability of charcoal and of hydrogen—a contrast which is utterly unfair, in so far as one of the elements is solid and the other gaseous. The author thinks the matter has been set at rest to the satisfaction of the scientific world by the excellent researches of Professor Harold B. Dixon on the explosion of gases; and anyone who now maintains the ancient doctrine that carbon is liberated in flames of hydrocarbons by the preferential or selective burning of the hydrogen, must be called upon to show that it is something more than a pious or an impious opinion. We are thus thrown back on the view which, the author believes, Davy always meant to teach—namely, that the carbon in flames is separated by the action of heat. That hydrocarbons are resolvable into carbon and hydrogen by the action of heat, has long been a fact of everyday knowledge; and that a flame has a structure eminently favourable to such an occurrence, everyone will admit.

But we now come to the hardest part of the chemistry of flame—that is, to the question of the steps by which the carbon and hydrogen are finally separated with more or less completeness. Until lately, no one has concerned himself closely with this question, except the illustrious Berthelot. The essence of Berthelot's doctrine has already been given. He denies the existence of any such simple action as that commonly described in text-books, according to which ethylene is resolved by heat into carbon and marsh gas. He says: "I insist on this point, that the immediate decomposition of a hydrocarbon does not consist in its resolution into its elements, but in its transformation into polymers, or into more condensed hydrocarbons, with loss of hydrogen." This was written a long time ago; but the author does not know that Berthelot has changed his opinion.

The only other general view which the author knows concerning the progressive decomposition of hydrocarbons, is that recently advanced by Professor Lewes—a view which, in a sense, is the opposite of that of Berthelot. Professor Lewes considers that carbon is set free essentially through the agency of acetylene; this hydrocarbon being formed by the action of heat on other hydrocarbons simple or complex, and being itself finally resolved into carbon and hydrogen. Many of you may know that the author has appeared as an opponent of this theory. In November, 1895, he criticized the theory in a paper read before the Chemical Society.* To this paper, Professor Lewes replied before the same Society in the following January. Since then, the author has written nothing on the subject. He had thought at one time that this would be an occasion on which he could suitably return to a full discussion of the acetylene theory, and had gone far towards writing a paper wholly devoted to it. He has, however, decided to confine himself to one part of the theory only. The author is anxious that you should understand his reasons for this.

Professor Lewes's theory is divisible into two distinct and essential parts. One deals with the change effected by heat on the hydrocarbons within a flame, resulting in the separation of carbon; the other part deals with the condition of the separated carbon, and the emission of light from it. The first part of the subject—that concerning the action of heat on hydrocarbons, and the examination of unoxidized flame gases—is one with which the author has had little practical experience. At one time, he entertained and expressed the intention to experiment upon it. But he has been deterred by what subsequently seemed to him to be insuperable difficulties connected with the subject; nor is he yet convinced that the information gained would be in any way proportionate to the time and trouble expended. In this the author may be entirely wrong; but since such is his belief, the utmost he could do with reference to this part of Professor Lewes's theory, would be to subject it to a criticism of a theoretical kind, which he fears would be infinitely wearisome, and perhaps altogether beside the mark. What the author proposes to do, therefore, is to address himself personally to Professor Lewes; and if Professor Lewes can satisfy the author that the difficulties the author finds in connection with this part of his work are answerable, he will on a later occasion duly acknowledge this. The author trusts that his action in this matter will not be misunderstood. By those who have concerned themselves with the study of these problems, he is sure it will not; for they will know how indefinitely a discussion of this kind may be prolonged, and to what little advantage.

(4) *The Cause of the Glow of the Separated Carbon.*—The author thinks that perhaps it will be of more interest if he devotes the remainder of his paper to a consideration of the explanation which Professor Lewes has given of the means by which carbon acquires its bright glow in a flame; and for this purpose he will, for the time being, accept Professor Lewes's statement, that the luminosity of a coal-gas flame is connected mainly with the formation and decomposition of an amount of acetylene which, where it is decomposed, constitutes between 1 and 2 per cent. of the flame gases. The sudden decomposition of this gas, according to Professor Lewes, localizes the heat of formation, which is then liberated in the products of decomposition, and so raises the carbon to incandescence. Beyond this, in his last publication, Professor Lewes attributes light also, though in a less degree, to the heat produced, when the carbon in the gaseous acetylene becomes converted into solid carbon. The author may remark that such a division of the matter is not permissible, for what is called the heat of formation of acetylene is known only in terms of solid carbon; and it is not impossible that the union of gaseous carbon with hydrogen to form acetylene would be exothermic—or, in other words, that the heat of decomposition of acetylene might arise wholly from the condensation of carbon vapour, which always takes place under our limited experimental conditions.

This supposition—that the exothermic decomposition of acetylene is the chief cause of the glow of carbon in a flame—is based on several experimental observations; the chief of which is that, when acetylene is passed through a tube heated to about 800°, it is decomposed with the emission of light. Professor Lewes has asked for a refutation of these fundamental experiments. It does not seem to the author that this is necessary, for it is not to the experiments, but to the arguments rested on them, that the author objects. According to Professor Lewes, when acetylene is passed through a tube heated to 800°, it is decomposed instantly into its elements. At the same time, he remarks that the glow produced is of a lurid character, and resembles that obtained when sodium is burned in carbonic acid. The glow, in fact, is one which corresponds to a temperature not greatly beyond that to which the tube has been heated before the decomposition began.

Professor Lewes goes on to state that, if the acetylene be diluted, a higher temperature is necessary to bring about decomposition, and that the rate of increase of temperature increases more rapidly as the proportion of acetylene in the mixture diminishes. When, therefore, we have a mixture of acetylene and other gases containing not more than 2 per cent. of acetylene, it would appear that the temperature necessary for the decomposition of the acetylene in this gas must be something like 2000°. Let us suppose this to be the case. We should then have, at 2000°, with gases containing 2 per cent. of acetylene, a

* See "JOURNAL," Vol. LXVI., p. 978. † *Ibid.*, Vol. LXVII., 747, 807.

process comparable with what goes on with pure acetylene at 800°. Now, if the last-named process does not afford evidence of a special and vivid exaltation of the luminous effect by the act of decomposition, it seems impossible to suppose that the act of decomposition in the case of the very dilute gas could contribute appreciably to the glow of the separated carbon.

The author thinks some confusion has arisen from allusions to the explosive properties of acetylene. It is quite true that acetylene under pressure exceeding two atmospheres, exhibits the properties of a high explosive, and when detonated by the preliminary explosion of a charge of fulminate of mercury, is resolved with practical completeness into carbon and hydrogen. The velocity of propagation of the action in this case is enormous; being, he supposes, of the order of a mile a second. The effect of heat upon acetylene partakes in no degree of the essential character of explosion. When the pure gas is passed through a tube heated to about 800°, a chemical change is produced, attended by the emission of light; but inasmuch as this change does not proceed spontaneously beyond the heated part of the tube, there is nothing in the nature of the self-propagating effect which is the distinctive feature of explosions. The acetylene is not wholly resolved into carbon and hydrogen, nor does the emission of light correspond to a heating effect, either localized or general, attributable to the resolution of more than a small fraction of the total acetylene into its elements.

The author had the curiosity to try whether smaller percentages of acetylene than those used by Professor Lewes were capable of undergoing luminous decomposition at high temperatures. He found that a mixture of hydrogen with 15 per cent. of acetylene showed the effect in question when passed through a highly-heated platinum tube; but he couldnot observe any luminous decomposition when a mixture of 91 per cent. of hydrogen and 9 per cent. of acetylene was passed through the same tube when heated to its melting-point by the addition of oxygen to the blowpipe flame. With a mixture of gases corresponding in composition to those which, according to Professor Lewes, exist just where luminosity commences in a flame, the author could obtain no sign of luminosity when the mixture was passed through a platinum tube heated until it melted; nor did a doubling of the quantity of acetylene make any difference. It seems from these experiments that such gases as those to which Professor Lewes attributes the principal luminous effect of a flame afford no light when passed between walls of metal at a temperature of 1800°.

The author believes—and there are strong purely theoretical grounds for this belief—that the decomposition of any acetylene that may be present increases the glow by merely adding to the general temperature; and if we calculate to what extent the temperature of a mixture of 2 per cent. of acetylene with 98 per cent. of marsh gas would be raised by the decomposition of the acetylene, we get a figure something like 100° C. On grounds which are purely practical, the author thinks that there is no evidence that the presence of 2 per cent. of acetylene at the part of a flame where luminosity is said to begin, is actually able, or likely to be able by its decomposition, to produce a luminous effect due in any appreciable degree to the heat of its decomposition.

The author believes that the light from the bright part of a hydrocarbon flame arises from particles of carbon which are intensely hot, because they are produced from highly heated gases, and because they exist in a region of very high average temperature. The author admits that there would be some ground for dismissing his arguments if it could be shown that the glow of the particles in a hydrocarbon flame surpassed that which could be fairly said to be due to the average temperature of their surroundings. The author has shown that this temperature is beyond the melting-point of platinum; and when one considers the radiative power of carbon—as shown, for example, by its use in the incandescent electric light—it seems to the author that it is as unreasonable as it is gratuitous to say that the glow of the minute particles in a flame is greater than corresponds to the temperature of the surroundings. The author does not think, therefore, that the acetylene theory is required to fill any gap in our knowledge, as far as the intensity of the emission of light from hydrocarbon flames is concerned.

In conclusion, the author wishes to say that he admires, and fully appreciates, the ingenuity of the acetylene theory; and that he would be sorry to be guilty of criticizing it in a captious spirit. If the difficulties which he has described, and others which he intends to put before Professor Lewes, can be removed, the author will be well satisfied to know, and to acknowledge, that his painstaking labours have been rewarded by a considerable advance in our knowledge of the science of flames. Professor Lewes's theory will be attractive to practical men in offering something like a chemical standard of measurement for the luminous power of flames, and in presenting some sort of rational basis for the consideration of the important question of enrichment. But the author is afraid we are in any case far from possessing a complete theory on these subjects; and the factors are so numerous that they will doubtless long defy the efforts of science. In burning a hydrocarbon to produce light, we want to get the maximum of minute carbon particles at the maximum of temperature. For this purpose, a certain amount of the hydrocarbon has to be sacrificed in order to produce the hot shell of burning gases which shall cause the separation of carbon, and heat this carbon to the highest possible temperature. At the same time, it is necessary that this carbon should get oxidized rapidly; otherwise the carbon particles agglomerate and, escaping oxidation, appear as smoke. In other words, the gas must issue from the burner so that the surface of the hydrocarbon stream exposed to oxidation has a certain relation to its other dimensions. This relation must, in the nature of things, be definite and ascertainable; and practically it is ascertainable by trial. But if we are to lay down a theory which will tell us exactly what form and dimensions are to be given to the stream of any particular hydrocarbon in order to get the maximum of light, it will be necessary to take into account the composition of the gas, the temperature of ignition, the temperature of its combustion, the progressive action of heat upon it, both as to change of composition and change of volume, the diffusibility of the original hydrocarbon and its decomposition products, and probably other factors. These things render at present all detailed reasoning on the subject futile; and the principles on which one can act are few and broad. It grieves the author to say it, but he believes that the question of the development of light from gas-flames, from the point of view of the gas engineer, is one on which, using a well-worn adage, an ounce of practice is worth a ton of theory. Be this as it may, it will not always be true; and, in his opinion, every ounce of sound theory may be welcomed as containing within it potentiality of immense ultimate practical advantage. Progress is slow, but he believes it is being made; and it is an encouragement to those who, like himself, are attracted to the study of flames from their scientific interest alone, to find that their efforts are regarded sympathetically by such an important body of practical men as make up this Institution.

Discussion.

The PRESIDENT regretted that Professor Lewes, to whom so much reference was made in the paper, was not present to open the discussion upon it, as it was not of a character easily discussable by the ordinary members of the Institution. He (the President) rather hesitated to suggest a postponement of the discussion; and if any members present desired to make observations on the paper, they would be gladly received.

Dr. COLEMAN (Saltley, Birmingham) thought it would be better that the discussion should be postponed until they had the advantage of the presence of Professor Lewes to "set the ball rolling."

The PRESIDENT said the discussion might well proceed as far as possible, as it was not certain that Professor Lewes would be able to attend.

Dr. COLEMAN remarked that they had all followed with much interest the work done by Professor Lewes and others during the past five or six years. He agreed with what had been said as to the extraordinary complexity of the subject, and the number of different theories which had been put forward upon it. In regard to the acetylene flame, in a recent paper it had been absolutely denied that any light was given out by acetylene unless mixed with air. Two German gentlemen tried the action of acetylene at various temperatures up to 900° C.; and they found that, if acetylene was absolutely free from air, no light was given off, as Professor Lewes described. But if

the acetylene contained the slightest trace of air, the result was a lurid flash, as spoken of. He would like to hear Professor Lewes's experience on this point, and to know whether he could or could not confirm the statement made.

Mr. W. Foulis (Glasgow) thought it a pity not to have some expression of opinion on the paper. They all regretted that Professor Lewes had not been able to attend and further explain his views on the luminosity of flame, in contrast with those of Professor Smithells. No doubt the subject was one of very great difficulty; but at the same time it was one of great interest. The author of the paper had said that many of them would recognize that in this connection "an ounce of practice was worth a pound of theory." Still if they could get Professor Lewes and Professor Smithells to arrive at some result as to the cause of the luminosity, knowledge would be obtained which would enable gas engineers to largely increase the illuminating power of coal gas. He (Mr. Foulis) scarcely felt competent to criticize the paper. As he understood, the difference between the two theories was that Professor Lewes held that luminosity was largely due to the formation of the acetylene, and then to the heat given off by its sudden decomposition; while on the other hand, the author of the paper attributed the light almost entirely to the incandescence of the carbon particles caused by the heat produced by the burning of the flame. This, he understood, was the principal difference between the two theories. It was of course very much a question of theorizing. He did not know whether practical experiments could be explained and reconciled; but in any case the question was one of great interest to manufacturers of illuminating gas.

Professor Smithells shared the regret which had been expressed by several speakers at the absence of Professor Lewes. At the same time, he was afraid that if Professor Lewes and himself got talking upon the luminosity of flames, they might either keep the meeting an unconscionable time or might be left alone altogether to carry on the discussion. (Laughter.) Personal equation entered so much into these problems, that it was very difficult in discussing them to be perfectly fair even with the best intentions. Dr. Coleman had raised a most important point—whether acetylene underwent any decomposition by the action of heat. He noticed an observation in a paper by Dr. Haber with regard to this; but it seemed to him (Professor Smithells) to be so inconceivable that such a fundamental mistake could have been made by Professor Lewes, that he did not really attach much importance to the remark in Dr. Haber's paper, especially as he found no actual record there of what was done at high temperatures. A few days ago, he made an experiment with the view of purifying acetylene—not perfectly, but fairly completely—from oxygen. He kept the acetylene in contact for some time with an alkaline pyrogallic solution; and then passed it through a heated tube. But he found very little, if any, alteration in the result. He had not mentioned this experiment in his paper, and did not wish to insist upon it now, because it was desirable to take all possible precautions in order to be able to speak with absolute certainty. Recent experiments in chemistry showed that enormous effects could be produced by the action or presence of very small quantities of foreign substances. When they knew that acetylene would not burn in oxygen without the addition of a very small quantity of moisture, they had to be careful to remove the slightest traces of foreign substances before speaking with any certainty. This might have been done by Dr. Haber. At any rate the question was of great importance. Mr. Foulis had, he thought, correctly indicated the essential difference between the standpoints of Professor Lewes and himself. Professor Lewes said the main proportion (80 or 90 per cent.) of the luminosity of a flame, arose from the sudden decomposition of the acetylene—the decomposition being attended with an enormous amount of heat. This was owing to the suddenness of the action on the acetylene, stored for the moment among the freshly liberated atoms of hydrogen and carbon. His own view was that it was due simply to the fact that the region in which it existed was at an extremely high temperature—above the melting-point of platinum. This was not his own view, though it was the one held by those who had paid most attention to the luminosity of flame. These were the conditions which it would be a very long and wearisome matter to follow out fully in the discussion. As Mr. Foulis had intimated, this was an important subject to them as gas engineers; and if they wanted to hurry on things, and to get the question decided more quickly than it would be in the natural course by private research, he would strongly advise them, if it were at all in keeping with their proceedings and powers, to appoint something in the nature of a Committee of Investigation. If the matter were to be brought to an issue by one man, the difficulties he had alluded to, and the tendency to the personal equation, would be great, and the results arrived at unsafe. If, therefore, they considered it of importance and urgency to know more of the action attending the decomposition of acetylene in the hydrocarbon flame, the investigation should be carried out by several people working together. He felt that the paper had a little missed its mark that day; but he had been quite prepared for this result. He was asked by the Council to read a paper on the subject—not on his own researches generally in flame, but on the luminosity of flame. To this topic he had specially addressed himself. He thought he might have made the paper more interesting and superficially attractive by introducing some of the old experiments, and treating the subject in an elementary manner; but this would scarcely have been in accordance with the wishes of the Council, or respectful to the body of members. He had therefore tried to put before them as succinctly as possible, the opinions he himself held on the subject of flame. Though there were not a great number present who would be interested in his paper, he hoped many connected with the gas industry would get from its perusal assistance in their work.

The President said he felt quite sure that, though the discussion had been incomplete, the paper itself would be recognized as of considerable interest and value. When he first read it, it seemed to him rather in the character of the lectures which used to be delivered to the Institution than a paper intended for discussion; and, personally, he was not disappointed that they had not had a good debate upon it. He was much taken with Professor Smithells' suggestion that the Institution should appoint a Committee to consider the subject of the luminosity of flame; and he would certainly bring it before the Council at their next meeting. Perhaps they might be able to combine it with the still pending investigations in reference to Standards of Light. It was surprising to find how many questions were involved in the apparently simple subject of the combustion of gas.

NOTES ON CYANOGEN AS A GAS-WORKS RESIDUAL.

By G. P. Lewis.

Introduction.—A somewhat recent encyclopædia, under the heading of "Cyanogen Compounds," describes them as a "class of compounds of great interest to chemists, but none of which have any great practical value."

Demand for Cyanides.—This statement is now no longer true; a considerable demand having since arisen for various forms of cyanide—principally potassium cyanide for export to gold-mining centres, potassium, or sodium cyanides, having been found to possess very active properties in dissolving metals, particularly when in a state of fine division, such as the very fine gold which is left in the "tailings" after the bulk of it has been extracted by the ordinary methods. They are also very extensively employed as metallic solvents for gilding, electro-plating, and such-like purposes. Ferrocyanides are now being manufactured in large quantities for conversion into cyanides; while sulphocyanides are in considerable request, not only for conversion purposes, but also for dyeing fabrics.

Gas-Works a Source of Supply.—This demand has drawn renewed attention to the fact that crude coal gas contains cyanogen, which is usually considered an impurity, and is generally removed in the lime and oxide boxes in the ordinary methods of purification. Cyanogen is recovered as a "residual" on a somewhat large scale in some of the Continental gas-works; whereas in England comparatively little has been done.

Nature of Experiments.—This fact induced the author to make a series of laboratory investigations in connection with the subject of this paper; and as some of the methods evolved in consequence promised success, he was provided with facilities for making a number of experiments on a practical scale, by the kindness of Mr. C. Gandon, Engineer to the Crystal Palace District Gas Company. The

experiments have extended over a rather wide range, and have been directed principally to ascertain the particular form of cyanide most suitable for manufacture in a gas-works, and also to determine the best class of apparatus to employ, and the cost of manufacture. Some of the processes tried were very interesting from a purely chemical point of view; and although very successful so far as proving certain theories in chemical combination, they are not likely to be of any service in a practical sense. The author therefore, does not intend to enter into details of these experiments, but proposes to confine his attention to those which promise success on a working scale.

General Remarks on Cyanides.—The manufacture of cyanides in a large way being practically a new industry, a few remarks on cyanogen compounds generally will not be out of place. The several forms of cyanides which may be recovered hereafter as "residuals" in gas manufacture, vary considerably in their composition, weight, and relative value—partly due to the fact that some are anhydrous, while others contain a large proportion of water. Thus ferrocyanide of soda contains 41½ per cent. of water, as indicated in the table given below.

TABLE *showing Relative Weights and Value of Various Cyanogen Compounds compared with Potassium Cyanide as a Unit.*

Name.	Formulæ.	Relative weight.	Relative value taking weight into consideration.
Cyanide of potassium* . .	KCN	1·00	1·00
Sulphocyanide of potassium *	KCNS	1·50	0·75
Ferrocyanide of potassium .	$K_4Fe(CN)_6+3H_2O$	1·08	0·50
Ferrocyanide of sodium †. .	$Na_4Fe(CN)_6+12H_2O$	1·32	0·45
Sulphocyanide of ammonium*	NH_4SCN	1·20	0·60

* Deliquescent. † Efflorescent.

Character of Cyanogen Compounds.—Most cyanogen compounds are somewhat unstable, and are only too easily decomposed into a variety of useless products. In many cases they do not crystallize well in aqueous solution, but require the use of alcohol, which, of course, adds to the cost of recovery. Many of them are very susceptible to chemical change in the presence of that very complex product "crude" coal gas, as some of its constituents possess important modifying influences, which tend to produce compounds with compositions nearly akin to the general forms given in the table, but which are much less stable. *However, provided the proper conditions are understood, there need not be any great difficulty in manufacturing any of the forms before mentioned.*

Stable Forms of Cyanogen.—Generally, the most stable forms of cyanides are the alkaline ferrocyanides, which also possess the merit of being readily crystallized from aqueous solution, and may be stored in the open; while cyanides and sulphocyanides are very deliquescent, and must be packed in casks or jars as soon as the crystals are freed from water.

Sulphocyanides Superior to Ferrocyanides.—A few years ago, ferrocyanides were considered superior to sulphocyanides for conversion into cyanides; but recent discoveries have turned the scale in favour of sulphocyanides.

Form of Cyanogen Present in Crude Gas.—The cyanogen present in the crude gas as it leaves the retort is either in the form of cyanogen (C_2N_2) or hydrocyanic acid (HCN); and is probably produced in the retort in accordance with the following chemical reaction:—

$$C + NH_3 = HCN + H_2.$$

The determination of the exact form in which it exists in the gas is very difficult, by reason of its susceptibility to chemical change in the presence of crude gas. A considerable divergence of opinion exists among chemists upon the point. Some suppose that it is present as sulphocyanic acid (HCNS). But this is a mistake, as this gas is decomposed in the presence of hydrogen into hydrocyanic acid and sulphuretted hydrogen. Neither does it exist as ammonium cyanide (NH_4CN), as any temperature exceeding 80° Fahr. destroys it; while many reasons might be adduced against the assumption that it is the form of ammonium sulphocyanide (NH_4) S(CN). A number of experiments made by the author clearly indicated that it was present as cyanogen or hydrocyanic acid.

Quantity Present in Crude Gas.—The quantity in the crude gas varies considerably with different temperatures of carbonization; the yield being greatest with the highest temperatures. But provided that the gas is distilled at not less than 1750° Fahr., the amount in the gas at various points in the manufacturing plants should be within the limits given in the annexed table:—

	Hydrocyanic Acid in Grains per 100 Cub. Ft.		
After retorts	84	to	132
,, condensers	82	,,	127
,, scrubbers	80	,,	124
,, 1st purifier	41	,,	62
,, 2nd ,, ...	26	,,	41
,, 3rd ,, ...	20	,,	26
,, 4th ,, ...	16	,,	18

The possible processes for practical recovery in gas manufacture may be divided into three groups—namely:

1.—Recovery from "crude" gas by washing it in chemical solutions.
2.—Recovery from gas liquor.
3.—Extraction from "spent oxide."

RECOVERY FROM CRUDE GAS BY WASHING IN CHEMICAL SOLUTIONS.

Consideration of Recovery as Cyanide.—If hydrocyanic acid, or a mixture of it with "purified" coal gas, is passed through a solution of potassium, or sodium hydrates, or carbonates, a cyanide of the alkali is formed. But with crude coal gas this is not the case, by reason of the fact that it contains other acid gases—namely, sulphuretted hydrogen and carbonic acid—which expel the hydrocyanic acid, and so prevent the formation of a cyanide. Therefore, the idea of producing a cyanide directly by washing the gas with an alkali must be dismissed as impracticable.

Recovery as Ferrocyanide.—Passing on, then, to the consideration of recovery as ferrocyanides, it may be stated that cyanogen, or hydrocyanic acid, has a great affinity for iron in the form of a sulphide, and readily forms cyanides of iron, which in their turn energetically combine with an alkali to produce ferrocyanides. Therefore, by passing crude coal gas through a special form of washer containing an alkaline solution, with an *excess* of insoluble iron in suspension, nearly the whole of the cyanogen can be recovered as ferrocyanide of the alkali, *provided* that the construction of the machine is such as will *ensure intimate contact of the gas with the iron held in suspension.* The most suitable form of iron to employ is precipitated ferrous sulphide. In the plan devised by the author, this is readily produced by precipitation from an iron salt, by means of a liquid prepared from the waste gases of an ammonia plant. If the alkali employed is carbonate of potash, the ultimate reaction in the washer is as per equation:—

$$2K_2CO_3 + FeS + 6HCN = K_4Fe(CN_6) + H_2S + 2CO_2 + H_2O.$$

Reactions.—The real reactions are much more complex than that given above; and in connection therewith, the author desires to state that the equations given in this paper are not intended to represent the changes which take place under all possible circumstances—the interactions being very intricate, and not always in the same direction. At first sight it may seem to be a very simple operation to recover ferrocyanide as herein described; but there are many points (both chemical and mechanical) which must be understood, if success is to be achieved.

Modified Forms of Ferrocyanides.—Under certain conditions there is a tendency to produce a liquor containing a modified form of ferrocyanide—probably $K_7Fe_2(CN)_{12}$—the presence of which renders the product less stable; but with an *efficient* form of washer, this should not occur.

Importance of Removing Ammonia.—It is also essential that the ammonia should be removed as far as practicable from the gas before it enters the special washer, for two principal reasons. The first is that the acids of the "fixed" ammonium compounds—such as chloride of ammonia, for example—form chlorides of the alkali employed, and render the product impure to that extent; and, secondly, may tend to produce a smell in evaporating down the crude liquor. Cyanogen may be recovered in the presence of considerable quantities of ammonia; but the method involved is not so economical.

Treatment of Crude Ferrocyanide Liquor.—The crude liquor running from the washers contains a certain amount of insoluble iron in suspension, which must be removed by special apparatus devised for the purpose. In evaporating the "crude" liquor, care must be taken to keep the temperature carefully regulated during the later stages, as

if by accident the crude cake should happen to be overheated, certain changes take place; and there is a risk of the ferrocyanide becoming decomposed. Therefore this is best effected by the aid of steam heat, as then overheating is impossible; and, in addition, there is less risk of boiling over. If the crude cake contains a modified form of the ferrocyanide, as before mentioned, the change apparently occurs at a lower temperature than expected, which emphasizes the importance of avoiding this formation by the use of an efficient machine for extraction. Potassium ferrocyanide overheated in the open becomes converted into potassium cyanate, which in the presence of moisture, again changes to potassium and ammonium carbonates. During the evaporation of the filtered crude liquor, a black flocculent precipitate settles out, which (though infinitesimal in weight) spoils the colour of the resulting salt. The author therefore proposes to evaporate the liquor nearly to dryness, re-dissolve the cake in a lixiviating tank, and allow the small quantity of solid matter to settle down, before running the liquor into the final evaporating-pan, where it may be converted into "cake" in preference to crystallizing, and thus save the manufacturer the trouble of driving off the water of crystallization.

Conversion of Ferrocyanides into Cyanides.—The crude liquor is usually found to contain a certain proportion of carbonate of the alkali employed; but this is not a disadvantage in the manufacture of a product for conversion into a cyanide, as ferrocyanides are converted by fusing them with a mixture of alkaline carbonate and carbon, in closed pots, in accordance with the following equation:—

$$K_4Fe(CN)_6 + K_2CO_3 + C = 6KCN + CO_2 + CO + Fe.$$

Weight and Value.—Ferrocyanide cake is of less relative weight than crystals, owing to the absence of water, and should therefore command a higher price. On the other hand, if it contains carbonate, this will increase the weight, but lessen the value per pound.

Yield per Ton of Coal Carbonized.—Supposing the coal to be carbonized in accordance with the conditions laid down earlier in this paper, the process just described should yield approximately the under-mentioned quantities of products per ton of coal carbonized: As ferrocyanide of sodium, 3 to 4·5 lbs.; as ferrocyanide of potassium, 2·4 to 4 lbs. A practical test on gas representing the carbonization of 15 tons of coal, yielded 45 lbs. potassium ferrocyanide.

Recovery of Sulphocyanides.—Sulphocyanides may also be recovered in a somewhat similar manner, and with the same form of apparatus (slightly modified as regards the evaporating-pans), by merely changing the reagents in the washing chamber.

Preparation of Washing Liquor.—The washing liquor is prepared by acting on an alkaline solution, with waste gases containing sulphuretted hydrogen. The proper composition of this liquor is a matter of experience, and must be varied according to circumstances, as the necessary reactions are largely influenced by the quantity of oxygen in the gas.

Assist in Removal of Carbon Bisulphide.—It may be interesting to mention, in connection with the above, that it seems very probable that the solutions prepared as described will assist in the removal of carbon bisulphide. At any rate, some small sample tests gave indications of it; but it yet remains to be proved that such will be the case on a large scale.

Evaporation.—The crude sulphocyanide liquor must be evaporated in enamelled steam-jacketed pans, as it has a marked action on metals during evaporation. This liquor does not appear to have any action on the ironwork of the washer, as was feared by the author; but it does so act on other metals—such as zinc—which are speedily eaten into holes.

Yield.—The yield per ton of coal carbonized should be as follows: Potassium sulphocyanide, 3·4 to 5 lbs.; ammonia sulphocyanide, 2·4 to 4 lbs.

Conversion into Cyanides.—Sulphocyanides can be converted into cyanides by fusion with finely-divided zinc, or other metals having an affinity for sulphur:—

$$KCNS + Zn = KCN + ZnS.$$

Recovery from Gas Liquor.

Crude Liquor Contains Cyanogen.—Crude ammoniacal gas liquor contains cyanogen, chiefly in two forms—namely, as ferrocyanide and sulphocyanide of ammonium.

Origin of the Ferrocyanide.—The ferrocyanide appears to be formed by the action of hydrocyanic acid on ferrous sulphide, in the presence of ammonia, thus—

$$6HCN + 6NH_3 + FeS = (NH_4)_4Fe(CN)_6 + (NH_4)_2S$$

the iron sulphide being derived from the framework of the washers and condensers. The quantity present, calculated as prussian blue, averages about 0·4 lb. per ton of coal carbonized.

Origin of Sulphocyanides.—The origin of sulphocyanides is somewhat involved, and does not appear to be entirely due to the cyanogen present in the gas. But it is undoubtedly partially produced by reactions within the liquor itself, in accordance with the following equation:—

$$(NH_4)_2S + CS_2 = NH_4CNS + 2H_2S.$$

The author has proved the general truth of the above equation by preparing an artificial liquor known to be free from sulphocyanides; and, imitating the conditions which may occur in scrubbers and washers, has succeeded in converting a portion of it into ammonium sulphocyanide, and also similarly increased the known quantity in a given sample of liquor. Its presence may also be accounted for by other chemical reactions, according to the following equations:—

$$2NH_4HS + O = (NH_4)_2S_2 + H_2O.$$
$$(NH_4)_2S_2 + HCN = NH_4CNS + NH_4HS.$$

Quantity Present Increased by Storage.—It is a peculiar fact that the quantity of sulphocyanides in the liquor is increased by storage. One particular sample analyzed by the author gave the following relative weights at intervals of one month—namely, 1·76, 3·5, and 4 grammes.

Analyses of about fifty samples yielded results ranging from 0·5 to 2 lbs. of ammonium sulphocyanide per ton of coal carbonized. At the Crystal Palace District Gas-Works, one test of liquor from 2 tons of coal carbonized gave 4·8 lbs. of cupreous sulphocyanide, equal to about 3 lbs. of ammonium sulphocyanide.

Attempts to Recover as Ferrocyanides.—Many attempts have been made to recover the ferrocyanides from gas liquor as prussian blue, by adding an iron salt to the liquor in the scrubbers, or to the liquor immediately before entering the ammonia stills. If the solution of a salt of iron is added to the liquor in the scrubbers, it increases the quantity of cyanogen recoverable; but it is open to the objection that the acid radical of the iron salt unites with the ammonia and produces a larger proportion of fixed ammonia, and also tends to cause stoppages in the scrubbers. The liquor in either case is passed through the ammonia stills in the ordinary way; the ammonia being driven off by the aid of lime, producing calcium ferrocyanide in the "effluent," which is run into a settling-tank, acidified, and treated with a further quantity of iron salt, which precipitates the ferrocyanides as prussian blue. In one or two instances, an alkali has been run into the scrubbers, with the idea that it would decompose the cyanogen, and set the combined nitrogen free as ammonia. This, however, is a somewhat fallacious procedure, as the action of the alkali would be the same as on any other fixed ammonium compound:—

$$NH_4CNS + KHO = KCNS + NH_3 + H_2O.$$

Attempts to Decompose Sulphocyanides.—Sulphocyanides can be so split up by chemical means; but as they usually resolve themselves into four or five more or less useless compounds, including bisulphide of carbon, gas engineers are not likely to view such methods with favour.

Suggested Evaporation of Liquor.—It has also been suggested that potassium carbonate should be added to the "effluent" liquor, and then evaporate it to dryness. But this is wholly impracticable, as the resulting cake would be very impure—involving a costly process of purification, apart from heavy expenditure for fuel. If, however, a soluble alkali is run into the fixed ammonia stills, then the same liquor might be used in the washers several times, until the percentage of cyanogen in it is sufficient to pay for evaporation. But there would be the same difficulty with the impure cake.

Author's Process.—In any practical process for the recovery of cyanogen from "effluent" liquor, advantage ought to be taken of the utilization of waste products as aids in the operation. The scheme of recovery devised by the author makes use of these to the fullest possible extent. The method of procedure is as follows: The ferrocyanides and sulphocyanides present in gas liquor are classed as fixed ammonium compounds, and are usually decomposed

in the ammonia stills by the use of lime; the ammonia being set free, and ferrocyanide and sulphocyanide of calcium formed:—

$$2NH_4CNS + CaO = Ca(CNS)_2 + 2NH_3 + H_2O.$$
$$(NH_4)_4Fe(CN)_6 + 2CaO = Ca_2Fe(CN)_6 + 4NH_3 + 2H_2O.$$

Recovery of Ferrocyanides.—The effluent liquor from the stills is run into a suction-tank, from whence it is pumped to the top of a tower filled with coke, bricks, or the like, down which it trickles, meeting an upward flow of sulphurous and carbonic acid gases (obtained in a manner to be hereafter described), which neutralize and acidify the strongly alkaline effluent liquor, and render it fit for further treatment. The liquor which flows from the base of the scrubber is run through a straining weir into one of the larger compartments of a settling-tank, where it is treated with a solution containing ferrous and ferric salts of iron, thereby precipitating the ferrocyanide as prussian blue. The tank is divided into two compartments, so that the liquor may be run into each alternately, and thus give time for the precipitate to settle; the supernatant liquor being then run off through a special overflow into a similar tank, where it can be treated for the recovery of sulphocyanides.

Recovery of Sulphocyanides.—The only insoluble sulphocyanides are those of silver, mercury, lead, and copper. It will be readily understood that the cost of employing silver or mercury as precipitating agents renders their use quite out of the question; while that of lead is impracticable. So that copper is the only medium available for recovery. If the liquor in the second tank is treated with a solution of a salt of copper—say, sulphate of copper—it throws down the sulphocyanide as insoluble white cupreous sulphocyanide:—

$$Ca(CNS)_2 + H_2SO_3 + 2CuSO_4 + H_2O = Cu_2(CSN)_2 + CaSO_4 + 2H_2SO_4.$$

Should the liquor be not previously treated with sulphurous acid gas, black cupric sulphocyanide is produced, which is partly soluble. As soon as the precipitate has settled down, the clear liquid may be run into drains or sewers, as it is then quite innocuous. The precipitate is allowed to lie in the tank until sufficient has accumulated for further treatment. The supply of sulphurous and carbonic acid gases for treating the liquor can be obtained by passing the waste gases from an ammonia plant through a furnace constructed and arranged to convert the contained sulphuretted hydrogen into sulphurous acid. The process described up to this point is somewhat similar to that adopted in connection with the Claus purification process, but differs from it considerably in the details of the apparatus employed.

Treatment of Precipitate.—The precipitated cupreous sulphocyanide can be removed from the tank as desired, and should then be well washed to remove impurities, and may be treated with a solution containing an alkaline sulphydrate, which decomposes it into an alkaline sulphocyanide in solution, and a precipitate containing sulphide of copper. Advantage is again taken of waste products, by passing a portion of the foul gases from an ammonia plant through a simple form of washer, containing an alkali in solution, to produce an alkaline sulphydrate for decomposing. The sulphide of copper is reconverted into a copper salt by exposure to air and then dissolving in acids, so that the same copper may be used many times over.

Conversion to Cyanides.—It is also possible to convert the precipitated cupreous sulphocyanide into potassium cyanide by a direct process.

Advantages of Process.—This process possesses a great advantage, as being a means of reducing the risk of creating a nuisance by disposing of the waste liquor; the treated liquor not containing anything more deleterious than soluble lime salts. Recovery by this method is also profitable; providing its application is on a sufficiently arge scale, and is estimated to yield a gross profit of about 3½d. per ton of coal carbonized, after making due allowance for cost of materials, fuel, labour, and depreciation.

Extraction from Spent Oxide.

Recovery in Germany.—In Germany, oxide of iron is often employed in the first purifiers. Consequently the recovery from spent oxide is practised there to a large extent.

Form Present in the Oxide of Iron.—The cyanide present is recoverable in two forms—namely, as ferrocyanide and sulphocyanide. Dr. Knublauch has shown that the relative proportions of these two forms vary considerably. Analyses of ten samples by him yielded results ranging from 0·4 per cent. of sulphocyanides and 99·6 per cent. of ferrocyanides, to 76·7 per cent. sulphocyanides and 23·3 per cent. as ferrocyanides. The samples containing the largest proportion of ferrocyanides command the highest prices in the market. Therefore it is desirable that the conditions governing its formation should be understood. Dr. Knublauch and Messrs. Renard and Delseau appear to have devoted considerable attention to the conditions existing in oxide purifiers which favour formation of ferrocyanides and retard production of sulphocyanides.

Conditions Favourable to Formation of Ferrocyanides.—The formation of ferrocyanides appears to be assisted by moisture in the materials and by the use of steam; while sulphocyanides are increased by the presence of ammonia in the purifiers, as they may be formed by reactions between hydrocyanic acid, sulphuretted hydrogen, and ammonia, and may also be produced by reactions in accordance with equations given later on, and, in addition, are favoured by a rise of temperature during revivification. The quantity recoverable is very much reduced by continuous regeneration with air or oxygen, as the sulphide of iron formed is being continually revivified; and consequently the proportion of iron that the cyanogen can combine with is very small, as it has but little action on oxide of iron. The prussian blue formed is also liable to be decomposed by a large excess of sulphuretted hydrogen.

Reactions.—The principal reactions between the hydrocyanic acid and sulphides of iron in the oxide boxes are as follows:—

$$F_2S_3 + 6HCN = Fe_2(CN)_6 + 3H_2S$$
$$FeS + 2HCN = Fe(CN)_2 + H_2S,$$

producing ferrous and ferric cyanides, which are afterwards oxidized to prussian blue $Fe_7(CN)_{18}$ during revivification. Ferrous and ferric cyanides are very unstable, and are liable to be decomposed in many ways, as indicated by the following reactions, which are only given to represent a few of the changes possible.

Possible reactions during revivification in the open may be thus:—

$$9Fe(CN)_2 + 3O = Fe_7(CN)_{18} + Fe_2O_3.$$
$$7Fe_2(CN)_6 + 3H_2O + 3O = 2Fe_7(CN)_{18} + 6HCNO.$$
$$6HCNO + 6H_2O = 6CO_2 + 6NH_3.$$
$$HCNO + NH_3 = CH_4N_2O.$$

Continuous regeneration with air, or oxygen, in the presence of moisture—

$$7Fe_2(CN)_6 + H_6 + O_3 = 2Fe(CN)_{18} + 3HCNO + 3HCN$$
$$3HCNO + 3H_2S = 3HCNS + 3H_2O.$$
$$3HCNS + 3H_2O = 3COS + 3NH_3.$$
$$3COS + 3H_2O = 3H_2S + 6CO_2.$$

Sulphocyanides may be produced by reactions as follows:—

$$NH_3 + HCN + H_2S = NH_4CNS + H_2.$$
$$Fe_2S_3 + HCN = HCNS + 2FeS.$$
$$HCN + H_2S + O = HCNS + H_2O.$$

The prussian blue formed may be decomposed by excess of sulphuretted hydrogen thus:—

$$Fe_7(CN)_{18} + 2H_2S = 6(Fe(CN)_2) + Fe(CN)_6H_4 + 2S.$$

Ferric Cyanides Unstable.—It will be readily seen from the above that ferric cyanides are especially unstable, and are easily decomposed under the conditions existing in the oxide purifiers. This accounts to a certain extent for the small proportion of cyanogen recovered by this method, which is a little over 50 per cent. of the cyanogen in the gas. The "wet" process for recovery is much superior from a theoretical point of view, as the cyanogen first combines with the iron as ferrous sulphide, thus:—

$$FeS + 2HCN = Fe(CN)_2 + H_2S;$$

producing ferrous cyanide, which immediately combines with the alkali to form a ferrocyanide. Once this is formed, it is stable.

If the system of recovery from oxide is practised in gas-works, it should be combined with some form of sulphur recovery; and as a further advantage, could be conveniently worked in conjunction with the "liquor process" devised by the author.

The sulphocyanides, being very soluble, can be dissolved out by being soaked in water; the washings being run into the liquor store tank, passed through the stills in the

ordinary way, and afterwards recovered as previously described. The sulphur may then be extracted in any suitable manner, and the oxide dried. The dried oxide is then put in a boiler with a mixture of lime and water, and boiled, which converts the prussian blue in the oxide into ferrocyanide of calcium in solution, which may be run into a precipitating tank, and treated with an acid and iron salts, which precipitates the ferrocyanides as prussian blue.

Summary and Conclusions.

Turning now to the consideration of the relative merits of the three main sources of recovery dealt with in this paper, there does not appear to be any doubt but that the system of washing the gas in chemical solutions is the best one to adopt, particularly in gas-works conducted under the same conditions as those existing in London, and also where lime is used in the first purifiers by preference. About 80 per cent. of the cyanogen in the gas can be recovered by this method, in place of about 50 to 60 per cent. from spent oxide. It also possesses the advantage of being capable of producing ferrocyanides or sulphocyanides at will, according to the state of the market; and from all points of view, it appears to afford the greatest margin for profit.

The last, but not the least, point for consideration is the question of what is the probable profit to be gained. The author believes that cyanogen can be profitably produced as a residual in gas manufacture; for it must be borne in mind that the gasmaker produces cyanogen whether he wills it or not, and has only the cost of recovery to meet, while the chemical manufacturer has first of all to produce ferrocyanides or sulphocyanides by means of furnaces and other apparatus (involving a larger outlay for renewals), followed by filtration and crystallizing as in a gas-works.

Supposing that the recovery of ferrocyanides is practised, it should yield (on an average) a profit of 9d. to 10d. per ton of coal carbonized; while sulphocyanides would probably produce from 14d. to 15d. per ton.

These figures include cost of materials (with a liberal allowance for waste if any), labour, fuel, packing, and depreciation, but are exclusive of interest on capital and general establishment charges. Favourable conditions of recovery, by reason of maximum yield, will increase the figures given by about 25 per cent.

The demand for cyanides is still on the increase, and appears likely to continue; and it will be probably met, in the future, largely from gas-works.

The author desires to acknowledge the assistance rendered in the laboratory work by Mr. R. A. Cripps, F.I.C., and Mr. R. A. Gandon.

Discussion.

Herr Voissen, invited by the President to speak, stated that he was perhaps the oldest potash maker in the world; and he was glad he had had the opportunity of hearing that day something as to the prospects of the cyanides industry. It was interesting to learn that there was a possibility of recovering the sulphocyanide and the ferrocyanide in the same process more or less, and in a cheap way; and also that the sulphocyanide would be used in considerable quantities. He was, however, doubtful whether it would be possible to use the large quantities which gas-works could turn out in the way of cyanides or prussiates as they were used now. It might be of some interest to the meeting to recall what had been practically the use of cyanides and prussiates hitherto. Until recent years, the principal use was to make prussian-blue for printing calicoes and for paper-staining purposes. When the system of aniline dyeing was introduced, it largely substituted prussian-blue for these purposes. Then followed the use of cyanide for the extraction of gold; but at first the process was too expensive. From Germany came the extraction of ferrocyanide from spent oxide; and it was then found possible to produce cyanide so cheaply that it could be used not only for gold extraction, but also for dealing with the tailings. The increased use of cyanide in this direction was enormously more than anybody could have expected. A Syndicate was formed in Germany; and they had entered into an agreement with the makers. They, however, made the mistake of putting the price of the article too high to make money out of it; and new prices had had to be fixed in Germany. It was at first difficult to make the article from ammonia, as was now done in Strasbourg, by Dr. Barnardo's process, in thousands of tons a year. Then there came out an interesting process—the decomposition of trimethylamine. It was passed through tubes, and split into ammonia and cyanide, so as to give cyanide of ammonia, and afterwards sulphate of ammonia. He thought this was the cheapest process that would ever be found for making cyanide, because practically (so he was told) the cyanide cost nothing—the ammonia covering the whole expense of recovering the cyanide. He should like to give his own idea as to the prospects of cyanides in general. In his own factory, it would be done away with, because they did not extract it either from gas or trimethylamine. At present, the price of 100 units of cyanide of potassium was, so far as he knew, something like 1s. It was sold at about 9d. per lb.; but he was told it would leave about 8d., after deducting commission, expenses, and so on, just as it was used in the Transvaal. The German Syndicate recently obtained some statistics as to the quantity of cyanide used last year. It showed that 6000 tons of cyanide had been used, and 7500 tons had been produced in the whole world. The question would now be whether, if the article got much cheaper—coming down (say) to 8d. or 7d. per 100 units of cyanide—it would be worth making; but he did not consider it impossible, by the process they had now, if even gas-works did not gain much out of it. The question would then be whether it would be possible to increase in large proportion the quantity used; and this would depend upon whether there would be more tailings in South Africa worked which were not workable now owing to the article being too expensive. According, however, to some reliable information which he had, the present price of 9d. allowed so many to work the tailings that had been accumulating since the beginning of the gold-fields, and more had been worked during the past two years than were produced now, that he did not see much prospect of a very large increase in the use of cyanide for the work. During the past year, as far as his information went, the use of prussiate or cyanide had increased 3 or 4 per cent. This meant that two or three years' tailings had been worked; and it did not appear to him that this was a very large increase. Supposing that a ton of coal gave 3, 4, or 5 lbs. of prussiate or cyanide, the millions of tons of coal carbonized in England every year to make gas would yield such an enormous quantity of cyanide of potassium that, unless it was found possible to make a nutritive compound out of it by-and-bye (laughter), or turn it into ammonia or make a manure of it, it would become quite valueless. It was, therefore, worth while to get some information as to the amount which could be produced in the world, supposing that other markets should be opened in which cyanides could be used.

Mr. W. Foulis (Glasgow) said this subject had engaged his attention for, he thought, some seven or eight years—in the first place, for many years in making experiments on the quantity of cyanogen in gas (its varying quantities depending on temperatures, and on the quality of the coal), and also on the best means of extracting it; and for the last three or four years he had probably been the only—a all events if not the only, the largest manufacturer of cyanides produced direct from coal gas. They were now producing in the section of their works where they had this process in use, something like 30 cwt. of cyanides every day. The last speaker had said a good deal about the prospects that existed for the use of cyanide; and unfortunately, while he did not exactly corroborate all he had said, at all events there was a great deal of truth in it. During the last few years, the processes that had been introduced for the purpose of forming cyanides were almost numberless. Glasgow had been, and was, the centre of the process for utilizing the cyanides for the purpose of gold extraction—the Cassel's Gold Mining Company holding the original patents, and being the principal parties connected with the process—and this, of course, had caused a great deal of attention to be directed to the subject of cyanides there. He believed one works had just been started that had spent at least £30,000 for the purpose of producing cyanide from the nitrogen of atmospheric air. Another method of producing it was by means of an electrical furnace; and a Company was being formed for this purpose. Another Company were using large quantities of sulphate of ammonia for the production of cyanide. More recently in Germany there had been developed a method of obtaining cyanide from the waste gases that were produced in the manufacture of beetroot sugar; and he was informed that one

sugar-works in Germany last year produced 1000 tons of cyanide from these waste gases. If this was the case, and looking at the fact that there were 60 sugar-works in Germany, which meant, at that rate, the production of 60,000 tons, it did not give gas producers a very good prospect of being able to make a great deal of money out of cyanides. At the same time, they had the cyanide in their gas, and this cyanide, wherever lime purifiers were used before the oxide purifiers, was very largely converted into ammonia; and therefore if they could extract the cyanide from the gas with any profit at all, it might be worth their while to do it. As he had said, he had devoted a great deal of attention to this subject, and a great number of the experiments mentioned in the paper were simply a repetition of those made years ago, before he began to practically manufacture cyanide. The essential thing in the process was that the ammonia should be thoroughly extracted from the gas before the cyanide was dealt with at all. In the specification of a patent which he took out four years ago for the process he had adopted, he mentioned this as being an essential feature. So far as he knew, it was then pointed out for the first time. The process was exceedingly simple, and there were no practical difficulties in it whatever. The only question was, of course, whether they could make it pay, and to what extent. Since the time they began making cyanide, the price had gone down, he believed, nearly one-half; and that was within a few years. Whether the price would revive or not, he did not know; he could not say he was very sanguine about it. With regard to the paper itself, he was certainly much surprised to hear the statement that sulphocyanides were more readily converted into cyanides than ferrocyanides. Some mistake must, he thought, have been made about that. Another point was with regard to the evaporation of the crude liquor until the whole of the water of crystallization was driven off. He thought this would be found not only unsatisfactory but absolutely unnecessary in practice. The process he had adopted was very simple; and he would briefly describe it. A scrubber was so arranged that the iron was kept in a thorough state of suspension. They ran in a properly-prepared mixture—prepared in accordance with its proper chemical equivalents—of carbonate of iron and carbonate of soda. The gas was then passed through the scrubber; and the cyanogen was taken up in the liquor in the form of ferrocyanide of soda. The liquor was run off, when, by a test which was regularly made two or three times a day, they found that the alkali had worked up to within about 5 per cent. They then drew off all the liquor; and it was put into evaporating-pans, and evaporated down to a paste—not too thick, but to a fluid paste. This was laid upon drying-floors, and allowed to dry, and very shortly it formed a hard cake, containing from 85 to 90 per cent. of ferrocyanide of soda—the other impurities being carbonaceous matters and also a certain quantity of uncombined iron. They did not consider it advisable to carry the process further. They sold the cake, and then, by a process not at all complicated, it was converted into cyanide. On an average they got about 5 lbs. of ferrocyanide of soda from every ton of coal; but this was dependent in great measure not only on the temperature at which the coal was carbonized, but also on the different kinds of coal used.

Mr. R. A. Cripps felt the paper was of great importance to gas manufacturers, because practically everything used in the cyanide-recovery process was to be obtained from the gas-works themselves. This seemed to him to be the important point of the paper. The last speaker had referred to a scrubber wherein the carbonate of iron was suspended together with carbonate of soda to recover the ferrocyanide of sodium that was produced. He said the liquor was evaporated to a paste, and then by exposure was dried into a cake, containing 85 or 90 per cent. of ferrocyanide of sodium. Of this cake he obtained something like 5 lbs. per ton of coal. Was he to understand that the 90 per cent. of ferrocyanide of sodium was in the anhydrous condition?

Mr. Foulis said it was not; it was crystallized ferrocyanide of sodium.

Mr. Cripps said it seemed to him that the process adopted had no advantage over that which Mr. Lewis described, of evaporating down until the water was almost entirely driven off from the ferrocyanide of potassium. There was considerable advantage in that, on account of the expense for carriage and such like which the presence of water would entail. There was an important point in regard to what Mr. Lewis mentioned as to the presence of carbonate of potassium in the ferrocyanide obtained; and it would be necessary that the proportion should be known when converting into cyanide. Also the proportion of water present, was a matter of importance. It was not dried to absolute dryness. The recovery of the sulphocyanide from the effluent liquor of the ammonia stills seemed to be a beautifully simple process. One point he would like to emphasize. It was stated that sulphurous acid gas was absorbed by the effluent liquor from the stills. It was very important that it should be thoroughly saturated with sulphurous acid, because, if not, complete precipitation would not be obtained. The cupric sulphocyanide was a practically insoluble salt; and the action of the sulphurous acid gas was to cause the cuprous salt to come down owing to its reducing action. Mr. Lewis had also remarked that in that case the cyanide could not possibly exist in the form of sulphocyanide of ammonia. That, of course, was due to the fact that the compound was readily dissociated by heat. Some of the remarks which had been made sounded to him rather pessimistic as to the future of cyanide recovery from gas-works. He did think that where any body of operators had at hand a quantity of valuable substances which could be recovered solely for the cost of its recovery, it was great waste to allow them to run down the drains. He failed to see why the process described by Mr. Lewis should not produce an article quite as cheaply as any of the others named.

Mr. T. B. Ball (Rochdale) said mention had been made of "a process;" but they had not had the process explained. He would be glad if Mr. Lewis could give them further details.

Mr. A. Colson (Leicester) inquired what was the cost of the apparatus.

Mr. Lewis, by the aid of diagrams, described the apparatus and method of working, after which

Mr. Foulis asked whether Mr. Lewis had seen the apparatus that was used in Glasgow, because he had exactly described it.

Mr. Lewis replied that he had not.

The President said this was another instance of men's minds working on parallel lines.

Mr. Lewis said the result was the same whichever form of apparatus was used.

Mr. W. B. Randall (Waltham Cross) asked Mr. Lewis if he could give them any information as to whether the illuminating power of the gas was affected in the process of the recovery of the cyanide by the washing in chemical solutions. He understood, from a source where the process had been tried, that the gain from cyanogen was more than counterbalanced by the loss in illuminating power. It did not seem to have been mentioned in the paper that the higher the heats used in carbonizing, the larger the yield of cyanogen compounds. It might be of interest to state that a company had been applying special oxide of iron for arresting the cyanogen compounds, for which they were paid so much per ton of coal carbonized.

Dr. Coleman (of the Saltley Gas-Works, Birmingham) said the paper was specially interesting, apart from the description of Mr. Lewis's own process, inasmuch as it brought before them a large number of facts which could only be found distributed in a great many books. Among the points for consideration the first naturally was how far the recovery of cyanide was likely to prove remunerative. Some of the views expressed on this point were pessimistic and some optimistic; but his own view lay between the two. Mr. Cripps thought that anything that could be recovered cheaply was worth recovering; but that was only true to a certain extent. Owing to the comparatively small quantities in coal gas, there was no chance of the cyanides being recovered from it direct; and so they were obliged, in order to get the cyanides from coal gas, to convert them into ferrocyanide or sulphocyanide, and then sell this to other people, who turned it into cyanide. That was where people who were making cyanides direct would get a great pull over those making only sulphocyanides and ferrocyanides in the first instance. In recovering it in the beetroot sugar factories, they got it from a bye-product at absolutely no cost, and converted it direct into potassium cyanide in the form in which it was required in the gold-fields; and it seemed to him if these

sugar factories could produce anything like the potassium cyanide that was required for the gold industry, there was not much chance for gas-works so far as the cyanide itself was concerned. Then they would be thrown back upon the demand for it for other purposes—calico-printing and prussian blue. The price had already fallen from 1s. 2d. to 5d. per lb.; and it remained to be seen whether its increased cheapness would result in an increased demand for it. With regard to the paper itself, it contained a number of experiments which Mr. Foulis said he had also made, and which they had likewise made at Saltley. On the question of the amount of hydrocyanic acid in the gas at the different parts of the apparatus, the variation given by Mr. Lewis was on the assumption that the temperature of the retorts was about 1750° Fahr. No doubt the higher the temperature, other things being equal, the higher the amount of hydrocyanic acid in the gas. He had found that considerable variations took place, even from day to day, in the amount of hydrocyanic acid in the gas, when the condition of the retorts and the coal coming in were as nearly equal as they ever could be in any two days in large works. The variation might amount to as much as 100 per cent. It was quite possible to get 80 grains one day, and 40 grains the next. When he said a day, he meant a test extending over 16 hours—the test was commenced one night, and the gas was allowed to pass through till the morning. He thought there could be no doubt that the temperature was the chief factor; but other things might come in, including the kind of coal and other circumstances they might not know of, which all affected the amount of hydrocyanic acid in the gas. The amount taken out by the condensers and scrubbers seemed to him to be somewhat small. It represented something like 2 to 5 grains from the condensers, and 2 to 3 grains from the scrubbers. It would vary in different works according to the nature of the condensers and scrubbers employed; and this, he thought, did not leave much cause for surprise. What did surprise him was that at the last purifier there was as much as from 16 to 18 grains usually passing; whereas they had found, at the outlet of the second purifier, that the hydrocyanic acid had completely disappeared, and no trace of it could be found. He believed Mr. Lewis used lime purifiers simply; while at Saltley they had two layers of oxide and two of lime, which would account for the great difference. With regard to the ferrocyanide of sodium, the water of crystallization was not given correctly in the text-books. It was given as 12 molecules of water. As a matter of fact, they found it was 10 molecules. He thought it better to sell the ferrocyanide of sodium on the basis of the anhydrous salt it contained, and not take the water into account. In regard to the recovery of the sulphocyanides and ferrocyanides, at present prices the value of the cyanogen in the sulphocyanides was considerably greater. He had calculated roughly that, at present prices, the value would be 1¾ more—that was to say, the sulphocyanide was worth 1¾ times as much as the ferrocyanide. He had not the figures; but he believed the amount of the sulphocyanide actually sold bore a very small proportion to the amount of the ferrocyanide sold. If they were to put as much sulphocyanide on the market as they did ferrocyanide, they would lower the value of the former in much greater proportion than if they only put on ferrocyanide. As far as he knew, the sulphocyanides were not used to any large extent in the aniline dye industry, and the number of colours so produced did not bear a large proportion to the output; so that the total amount required would not be very great. This was a point deserving of consideration before deciding that the sulphocyanide was of more value to recover than the other. In sulphocyanide, they had a hygroscopic substance to deal with, which necessitated a great deal more trouble in the packing and so forth; but he understood that Mr. Lewis had allowed different sums for packing the sulphocyanide and the ferrocyanide. As to the equation given for the conversion of ferrocyanide into cyanide, he would like to know whether this was a process that was really being worked on a manufacturing scale, and whether it represented anything like what really occurred.

Herr Voissen thought it might be interesting to some members to know there were two kinds of prussian blue used. One was what they called gas blue, as produced in large quantities at the Beckton Gas-Works. They made the prussiate of the blue they got out of the scrubber; and they boiled it with soda or potash. They did not call it prussiate, but sold it as blue; and the principal market for it was among paper makers. It had more or less an irregular shade; and it could not be used as a substitute with certainty for the stable blue which must be made out of prussiate of potash.

Mr. Ball asked the total output of sulphocyanide?

Herr Voissen said the output of sulphocyanide was very great in the German manufactories which worked spent oxide; but it was almost valueless. If produced in large quantities, it had to be run into the drain. He himself last year allowed several hundred tons of sulphocyanide to pass into the drains.

Mr. C. Gandon (Lower Sydenham) said Mr. Lewis had been making experiments at the Crystal Palace District Gas-Works; and they had taken a great deal of interest in them. He (Mr. Gandon) must confess that he had always had an idea that the commercial point was the one that must be considered, because, so far as he had been able to understand, the demand for all these cyanogen compounds was very limited; and if all the gas-works in England were to produce them, he was afraid the supply would be much larger than the demand. The subject was exceedingly interesting; and he would like to see some of the suggestions carried into operation if possible, though he had his doubts about the result. One remark Mr. Foulis made rather struck him; and he should like to ask whether he had had any experience in that direction. He understood him to say that, where the cyanogen compounds passed forward into the purifiers, they were likely to be converted into ammonia, because if that was so, rather than try to recover the cyanogen compounds as sulphocyanides or ferrocyanides, he would convert them into ammonia. That was a point which required very careful consideration. The manufacture of these cyanogen compounds was a comparatively new one in gas-works; and it was very questionable how far it would be commercially beneficial to them.

Mr. C. Hunt (Birmingham) was rather surprised that Mr. Gandon should have asked the question with regard to the conversion of the cyanogen compounds into ammonia, because as a fact that was done. He had frequently found traces of ammonia at the outlet of the purifiers; but not in sufficient quantities to pay to recover. As Mr. Gandon said, the commercial aspect of the subject was perhaps the most interesting, because upon that must stand or fall the question of the recovery of this residual. He, however, took a more hopeful view of the matter than one or two of the other speakers. It seemed that the most formidable competitors at the present time were the beetroot sugar manufacturers in Germany, who now recovered the cyanide in large quantities, and the contest would probably be between them and the gas makers. The beetroot sugar manufacturers were supported in their country by the bounty system. But it was not at all certain that this system would endure; and they as gas makers, should persevere in their efforts to produce a simple process for the recovery of this residual, in the hope that they would ultimately be successful. He would like to ask Mr. Foulis whether he had ever experienced any nuisance arising from the manufacture.

Mr. Foulis replied that there had been none whatever. Anyone might walk through the place without knowing the process was in operation.

Mr. Lewis, in replying to the discussion, said they were all much obliged to Herr Voissen for the information which he had given. As to the quantity of cyanide required, it was a difficult matter to get at the bottom of. He had himself tried several times to obtain the information; but he could never secure any figures upon which he could depend. Then with respect to obtaining cyanide from beetroot refuse, both in sugar-works and in gas-works the cyanogen was merely obtained as a bye-product, whether they wanted it or not. It was simply a matter not of cost, but whether the temperature was sufficient to produce it. As Mr. Hunt had said, the contest in the future would be largely between the gas-works and the sugar-works. As to the conversion of sulphocyanides, that was another point upon which it was very difficult to get accurate information. Where it was successful, no information was divulged; but he had it on the authority of a gentleman who was in a position to know, that it could be converted. In reference to the form of the apparatus, he had, generally speaking, devoted his paper more especially to a general consideration of the subject. He had not

brought forward any particular apparatus of his own, but had dealt with the matter as a whole—simply incidentally referring to the apparatus he had sketched out in the diagrams exhibited. Naturally, different apparatus for this purpose must, in external appearance, be much the same. He did not think he had any other information about Mr. Foulis's process, except the patent specification; and so far as he could see, it differed from his (the speaker's) proposals. Then as regarded the effect of the process on the illuminating power of the gas, no experiments had been carried out; but he had been given to understand that it made no difference.

Mr. FOULIS said it did not.

Mr. LEWIS (proceeding) said as to the use of oxide of iron in purifiers, he believed there were some makers who allowed the oxide to be used and then returned; and, in fact, he understood they gave something for the use of it. That was only the case where the oxide was used in the first purifier. Then as to the manufacture of cyanide of potassium direct. That was a very important thing; and if it could be achieved in gas-works, it would be a great advance, and save an amount of profit. Into this question however, he had not had time to go; but he had no doubt that at some future date, some other gentleman would attack the problem. It was in that, he believed, that some of the future success of the process lay. As regarded the price of ferrocyanide and sulphocyanide respectively, as Dr. Coleman had pointed out, the relation was something like 1¾ more for the latter. But here, again, it would be an advantage to find out what were the quantities required; and if the information given him was true, there should be a demand for sulphocyanides. The question of the packing of sulphocyanide was no doubt important. It meant considerable extra cost; but supposing some system could be devised of converting them direct in gas-works, the expense of packing would be largely saved. As to the equation for the conversion of potassium ferrocyanides, that had also been given to him as being practised; and he took it to be true, though he had not had an opportunity of carrying it out on a manufacturing scale himself. Mr. Colson's question as to the cost of the apparatus, he could not answer.

The PRESIDENT said the paper was an illustration of the many-sidedness of their industry to which he had referred in his address, and clearly there was within it room for a considerable amount of investigation. They were much indebted to Herr Voissen for the information. he had given them. That gentleman had come over to England to get information; and he trusted he had received it as freely as they were able to impart it. Certainly Herr Voissen had readily reciprocated anything he might have received here. With regard to the demand for cyanides, he (the President) felt there was probably in front of them a very considerable and enlarging demand.

The Institution of Gas Engineers and the Sulphate of Ammonia Question.—We learn from the Secretary of the above-named Institution (Mr. T. Cole) that the circular recently distributed by the Association of Sulphate of Ammonia Manufacturers (see *ante*, p. 892) was considered by the Council last Wednesday. They felt that they could not take direct action in the matter; but they suggested that a paper from a prominent agricultural chemist should, if possible, be prepared for the next meeting of the Institution, and that this could be placed at the disposal of the subscribers to the circular for general distribution among users of sulphate of ammonia.

A Bunsen Burner for Acetylene.—At the meeting of the Chemical Society on the 6th inst., Mr. A. E. Munby, M.A., described and exhibited a bunsen burner he had devised for the consumption of acetylene. The disillumining of the acetylene flame by the introduction of carbonic acid had been described by Professor Vivian B. Lewes; but carbonic acid was expensive, and it greatly moderated the temperature of the flame. Acting on a hint from Mr. T. Fletcher, of Warrington, Mr. Munby endeavoured to so alter the dimensions of an ordinary bunsen burner that it should serve for use with acetylene. He found that the burner-tube should be narrowed to an internal diameter of 5mm., and the gas should be supplied to it at a pressure of not less than 6 inches of water. The burner then consumed about a cubic foot of acetylene per hour. The flame became luminous when the gas supply was considerably diminished, owing to insufficient air being then drawn through the inlets. In practice, acetylene was found to be twice as effective—in boiling water, for instance—as the same volume of coal gas. The burner would be very useful in laboratories removed from town gas supplies, as an acetylene generator was not very costly, and the connections were readily made.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1078.)

BUSINESS on the Stock Exchange remains within very reduced limits. The public are still very cautious, and seem to think the time is not yet quite ripe for them to come in. However, a fair amount of buying went on all the same; and prices, except in markets under special influences, had a fair rise. Discarding the mendacious despatches of the guileless Greek, it was felt that the unbroken successes of the Turkish arms must speedily terminate the conflict; and to this fair prospect was added the more favourable intelligence from the Transvaal. Thus the markets had a good week. There was a little profit-snatching before the close; but a good advance upon the opening figures remains. Money is most abundant; and rates in the open market are of the easiest. The Gas Market was buoyant and active; and some considerable advances in quotation were effected. In Gaslights, the "A" was a little uncertain at first. On Monday, it opened at 311, then dropped three points, but quickly recovered them again, and closed one point to the good. It then ran up gradually until on Friday it changed hands at 314. The secured issues came to the front at last; and an advance in values, so long deferred, could no longer be avoided. The "G" led the way with a rise of 10, which might well be even increased if there were any quantity of the stock to deal in; and the other preferences followed suit with lesser advances. Not very much was done in South Metropolitans; and the price seems to stick fast at about 142½. A small transaction in the old stock was all that was marked in Commercials. The Suburban and Provincial division could show more business than they have recently averaged; but prices were not remarkable either way. Brentford preference was up; and British was down. The Continental group were very fairly active. Imperial was dealt in at steady figures all through the week; and Union and European also were unchanged. Among the rest, there was considerable business in Belgrano issues, without variation of prices. The only change was an advance in San Paulo. Business in Water stocks was quite up to the average amount of activity; but no marked tendency was apparent. Prices for the most part were only moderate; but Chelsea had an appreciable fall. Lambeth 10 per cent., however, had another small advance.

The daily operations were: The Gas Market was pretty active on Monday, especially in Gaslight "A," which advanced 1. The "G" preference also rose 5. In Water, Chelsea receded 3; but Lambeth tens advanced 2. Business in Gas was a good deal quieter on Tuesday; but Gaslight issues were full of rise. The "A" advanced 1; "C," "D," and "E," 2; "F," 5; "G," 2; and "J," 3. In Water, Chelsea Water fell 1 more. Transactions in Gas were more brisk on Wednesday; and prices ruled very steady. Quotations remained unchanged. Business on Thursday was active, and was more distributed through the list. A further rise of 3 was marked in Gaslight "G;" and Brentford preference gained 2. Activity in Gas was fairly maintained on Friday; and prices were mostly very good. San Paulo advanced ½; but British was ½ lower. Saturday furnished a fair amount of business in the two big issues, and at steady prices; quotations closing without further alteration.

THE VALUE OF SPENT OXIDE.

ON the occasion of the recent meeting of the Association of Mid-Rhenish Gas and Water Engineers, Dr. Auerbach read a paper on the subject of spent oxide of iron, a summary of which is given below. We may remind our readers that in Continental gas-works the gas usually passes direct from the scrubbers to the purifying vessels charged with oxide; and Dr. Auerbach's remarks must therefore be taken to refer to oxide fouled under these conditions. It should also be borne in mind that the observations recorded do not emanate from a gas manager, but from a manufacturing chemist engaged in working up spent oxide.

The coke, tar, liquor, and gas from different gas-works vary but little in composition and properties, but the fouled oxide exhibits the most diverse characteristics. Sometimes it is in a hard powder; sometimes in stony lumps; and sometimes in a pasty mass, one-half of which is sawdust or wood chips. Its colour ranges from yellow to red and brown, or to black and different shades of blue. In chemical composition, it varies greatly. It contains from 2 to 40 per cent. of water, from 10 to 55 per cent. of sulphur, from *nil* to 16 per cent. of sulphocyanides, from *nil* to 8 per cent. of ammonia, and from *nil* to 15 per cent. of prussian blue. These colossal differences show that insufficient attention is paid in many works to the method of using oxide. Dr. Knublauch has already shown* that the dry purification of gas should be a considerable source of revenue to the works; and he has given figures which prove that at Cologne the spent oxide yields much profit. The Cologne method of using oxide may be adopted at any works, and equally good results be secured.

* See "JOURNAL," Vol. LXVI., p. 1294.

If we summarize the conclusions to which theory and practice point, we find there are three matters to which attention must especially be given. The first is the quality of gas entering the purifier; the second, the condition of the purifying material; the third, the treatment of the material during use.

With regard to the quality or nature of the gas. In practice no control can be exercised over the cyanogen, which is the constituent of gas which imparts value to the spent oxide. More important considerations must rule the selection of coal. One portion only of the cyanogen in crude gas is recovered in the spent oxide; another is previously absorbed in the liquor; and the residue remains in the gas. But it is quite possible to eliminate constituents which hinder the accumulation of the cyanogen in the oxide. Water is one such constituent, as it diminishes the porosity and activity of the material. Therefore the gas should be thoroughly cooled before it enters the purifying vessel, and in cold weather the latter should be slightly heated to prevent further condensation of moisture from the gas. Tar is even more disastrous to the porosity of the material than water; and, moreover, it is harmful because it prevents the recovery of the cyanogen from the spent oxide, and thus makes the latter less saleable. Therefore if the tar-extracting apparatus has not completely removed tar from the gas, the first purifying vessel, or at least one tier of it, should be charged with coke or sawdust, in order that the particles of tar may be retained therein. The greatest hindrance, however, to the formation of blue in the oxide is ammonia. Dr. Knublauch, in the paper already referred to, has clearly proved this. Whatever ammonia escapes the washers is not only lost to the liquor but injures the work of the purifiers. Sulphuretted hydrogen and hydrocyanic acid only require the presence of ammonia, or other alkaline substance, in the oxide to effect their combination to sulphocyanide. Not only is the nearly worthless ammonium sulphocyanide obtained in place of the valuable prussian blue, but the ammonia salts formed rapidly destroy the porosity and efficiency of the oxide. Therefore every means must be adopted to secure the removal of all ammonia from the gas before it enters the purifiers. Generally, even if the scrubbing apparatus is somewhat inadequate, a better system of irrigation or more judicious arrangement of the scrubbers will tend to improve their efficiency.

As to the condition and nature of the purifying material—excluding solution of iron as used according to Dr. Knublauch's patent and lime—there are many exhaustive memoirs on the subject. Laming's material (still commonly used in French, Italian, Spanish, and Oriental gas-works) is made by saturating a mixture of sawdust and lime with a solution of iron sulphate, and obtaining by precipitation on the sawdust hydrated oxide of iron. The defects of Laming's material are that it consists chiefly of sawdust, which is inactive as a purifying agent, and that the excess of lime present converts the hydrocyanic acid into sulphocyanides, and thus hinders the accumulation of blue. In fact, it scarcely pays to extract even the sulphur from spent Laming's material. The alkaline purifying materials, which consist generally of the hydrated iron oxide mixed with soda, which remains as a residual after alumina is extracted from bauxite, have the same inherent defects as Laming's material. The oxide is, indeed, in a state of fine subdivision. But its proportion to the total mass is low, and the alkali present induces the formation of sulphocyanides; while the material is too dense to be used without admixture of some lightening material, which brings other disadvantages in its train.

All kinds of waste products from chemical industries have been proposed as purifying agents; but they are for the most part worthless. They all are far inferior to the natural bog iron ore. This is found in many localities, and varies greatly in physical and chemical properties. A good bog ore should be soft and free from hard lumps, but not so finely granulated that it is dense and impervious. The pores of the mass should take up about three-fourths of its total volume. It may then be used without extraneous material being needed to lighten it. The important and active material is the hydrated oxide of iron; but it by no means follows that the ore which is richest in iron is the best. In England, too much importance has generally been attached to the percentage of iron in bog ore. The oxide must be completely hydrated; and there must be present sufficient fibrous material to ensure the porosity of the mass. The water in good bog ore will amount to 40 per cent. and upwards; and provided only water and organic substances are present, a low content of oxide of iron is not harmful. If, in addition to these substances, there is much silica and alumina, the material is not good, as these constituents are useless ballast.

Coming to the third point—the use of the oxide—it is most important that the purifiers should be sufficiently capacious for the work they have to do. The rate of flow of the gas through the vessels should not exceed a foot per minute. The oxide should be in shallow rather than in deep layers; and, as already indicated, the temperature of the vessel should be artificially maintained in cold weather. But care must especially be bestowed on the revivification. The material must not be piled in heaps, for it will then heat too strongly. Thus the oxide will be dehydrated, and its efficiency impaired; while the valuable cyanogen compounds will be destroyed, and ammonium sulphate formed from them. The oxide should be spread in a layer from 8 to 12 inches deep, and furrowed to facilitate access of air. The amount of ammonium sulphate in spent oxide is a good indication of the care with which revivification has been conducted. Its formation must be prevented by spreading out, turning over, and besprinkling the oxide. One point is often neglected, to the detriment of the spent oxide. The oxide should always be revivified after the last fouling, just as after the earlier ones. If piled in a heap, or loaded up for transport, without previous revivification, it will heat greatly, and there will be a considerable loss of prussian blue. Even after revivification, spent oxide should not be stored in very deep heaps, as the oxidation of the fine particles of sulphur often causes great heating, which will destroy the cyanogen compounds. The spent material requires very careful handling, as its high value, which has taken months to attain, may be dissipated in a few days by careless treatment. The readiness with which rich samples of spent oxide change into a dry mass, poor in blue, but rich in ammonium sulphate, is the cause of the frequent analytical disputes between vendor and purchaser. Occasionally revivification of oxide *in situ* has been adopted for the purpose of securing a higher duty from the vessels. Air and steam are injected into the vessel so soon as it is fouled; or, as in England, about one-half per cent. of oxygen is mixed with the gas at the inlet of the purifier, and the material is thereby continuously revivified. At Göttingen, the same result is attained by admixing 1½ to 2 per cent. of air with the gas, and subsequently carburetting the latter to compensate for the loss of illuminating power due to the addition of atmospheric nitrogen. The results are satisfactory; but it is difficult to prevent the undue heating of the material and the formation of ammonium sulphate.

With regard to the assay and valuation of spent oxide, it is all-important that large and representative samples should be taken, in the first instance; and, when they are thoroughly mixed, that the average sample should be kept in a tight bottle. Disputes often arise through defective sampling or careless storage of the sample. Dr. Knublauch's method of estimating blue in oxide is that now generally accepted; and it is highly desirable that one method should be adhered to by the analyst. The results of the analysis do not directly indicate the market value of the oxide, for several reasons. For instance, it is more costly to extract the blue from a poor than from a rich spent oxide; and therefore the price per unit of blue must be lower for poor than for rich samples. The physical condition of the spent oxide also affects its value.

In the course of the discussion on Dr. Auerbach's paper, Herr Lux, of Ludwigshafen, took exception to the condemnation of the alkaline hydrated oxide, and stated that at Hanover such material had given, in practice, as high a yield as 14 to 16 per cent. of ferrocyanide. A high percentage of sulphocyanide was, he said, wholly due to incomplete removal of ammonia from the gas.

The Costs in the Water-Gas Libel Case.—It is currently reported that the total amount paid in Counsel's fees in the case of *Fox v. Jerome*, the decision in which was given yesterday, as reported in our "Legal Intelligence," is somewhere about 5000 guineas. Sir E. Clarke is at the top of the list with 1300 guineas, including "refreshers;" and the others follow in proportion to their legal standing at the Bar—the lowest amount received by one of the juniors being 250 guineas. The jury have each been paid a special fee of a guinea a day for sixteen days, and have been exempted from further service for five years.

The Imperial Victorian Exhibition at the Crystal Palace.—Nothing could be more fitting than that the Crystal Palace (in the opening of which as the first "Exhibition of All Nations" the Queen took the most prominent part in 1851) should be associated with the Diamond Jubilee commemoration by collecting under its roof a vast number of exhibits indicating the marvellous progress which has been made in the arts and industries of our country during Her Majesty's long reign. The exhibition, which was inaugurated on Thursday last by H.R.H. Princess Christian, is at present somewhat incomplete; it having been originally intended to open it towards the close of the month. The sections which are most imperfect are those in which the bulk of the readers of the "JOURNAL" are professionally interested—viz., the Light and Heat and Machinery Sections. But nevertheless they promise to prove attractive features. Two of the competing systems of lighting—gas and electricity—are to be well represented; and their applications to heating and cooking will be shown. Chiefly to Messrs. William Sugg and Co., Messrs. Fletcher, Russell, and Co., Messrs. C. Wilson and Sons, and Messrs. Henry Greene and Son, is entrusted the task of showing the developments in the use of gas; and the names of these firms are sufficient guarantee that, so far as space will admit, there will be an effective display. The Hot Water Supply Syndicate will show their system of utilizing the waste heat of gas-flames for heating water and air. In the electrical department, the Edison-Swan Electric Lighting Company, Messrs. Crompton and Co., Mr. H. J. Dowsing, and the Brockie-Pell Arc Lamp Company will be the principal exhibitors. An electric oven will be shown, heated on all sides and on top; each part being controlled by a separate switch, so that (we are told) perfect regulation is assured. The cost per hour of cooking by this oven is, calculated at the modest price of 3d. per unit, put down at 1½d. per hour. The interesting collection of treasures of art and knowledge will, of course, form the body of the exhibition.

PERSONAL.

Dr. FRANK CLOWES, of Nottingham, has been nominated for the presidency by the Council of the Society of Chemical Industry; and he has expressed his willingness to accept the honour.

The personal estate of the late Mr. J. W. HARRISON, a Director of Messrs. William Jessop and Son, Limited, of Sheffield, and of the Sheffield United Gas Company, who died on the 1st of March, has been valued at £239,675.

Mr. J. G. LANGHAM, who had been Secretary of the Uckfield Gas Company from its commencement in 1858, resigned the position a short time since; and Mr. GEORGE EARL, his assistant, has been appointed in his place.

Mr. JAMES DEAS, the Engineer of the water-works and Manager of the sanitary depôts of the Warrington Corporation, has submitted his resignation. He was appointed Water-Works Engineer in 1895; but he has occupied the position of Manager of the sanitary depôts since 1891.

Mr. W. J. ARLISS, who, as mentioned last week, has just retired from the position of Chief Clerk to the Crystal Palace District Gas Company, has been presented with a revolving-top pedestal writing-table and gilt carriage clock, as a mark of esteem and regard, by his fellow-officers.

Mr. W. STAGG, of Bristol, has been elected a member of the Institution of Mechanical Engineers. It may be remembered that Mr. Stagg read a paper on "The Production of Steam and Power" at the final meeting of the South-West of England District Association of Gas Managers in April last year.

We learn that the vacancy in the office of Gas Engineer to the Salford Corporation, caused by the appointment of Mr. S. Y. Shoubridge as Engineer to the Crystal Palace District Gas Company, has been filled up by the promotion of Mr. W. W. WOODWARD, the Deputy-Engineer, who has been with the Corporation for the last thirteen years.

Mr. CECIL OWEN, who was Private Secretary to Sir A. Arnold during his tenure of the office of Chairman of the London County Council, has been appointed Secretary to the London Water Commission, the constitution of which was noticed in our "Parliamentary Intelligence" last week. Mr. Owen has already had considerable experience of the work with which he has been entrusted; having been Secretary to the Welsh Land Commission.

Mr. T. STENHOUSE, F.I.C., F.C.S., Chemist and Gas Examiner to the Rochdale Corporation, has been voted an advance of £30 in his salary. That his services are held in high appreciation by the Gas Committee was clearly shown by the remarks of Mr. Ford (speaking in the absence of the Chairman, Alderman W. J. Petrie) at the meeting of the Town Council last week. He said that, besides the good results Mr. Stenhouse had obtained from the bye-products—results which were much better on the percentage of material dealt with than those obtained at many large gas-works—he acted as Manager in the absence of the Engineer (Mr. T. B. Ball), and was practically Sub-Manager. He was a good unassuming servant, and had his work at heart.

The forty-fifth year of the connection of Mr. GEORGE DAWSON, J.P., Managing-Director of Messrs. Newton, Chambers, and Co., Limited, with the firm, has lately been celebrated by the presentation to him of a testimonial, consisting of a silver tea and coffee service, an afternoon tea set, and candelabra, together with an illuminated address. The presentation was made by Mr. J. Hobson, a foreman who entered the service of the firm the same year as Mr. Dawson. As showing the growth of the undertaking, he said that at that time they made 100 tons of pig iron a week; whereas now they produced 600 tons. Then they had no railways; now there were two reaching to every part of the country. In many of these extensions Mr. Dawson had taken the leading part. There were 1500 subscribers to the testimonial; the address having 50 signatures. In acknowledging the gifts, Mr. Dawson supported what had been stated as to the extensions at the Thorncliffe works. He said that when he entered the firm they paid in wages £45,000 a year; now the amount was upwards of £300,000. He also referred to the enormous growth of the local villages.

NOTES.

The Forecasting of Cold Periods.

At the last monthly meeting of the Meteorological Society, Mr. W. H. Dines read a paper on "The Relation between Cold Periods and Anti-Cyclonic Conditions of Weather in England during the Winter." One of the most important considerations in regard to winter weather, is as to the probable duration of cold periods. Mr. Dines observed that there seems to be a generally accepted belief that anti-cyclonic conditions in the winter season are likely to be accompanied by exceptional cold. But so far as England is concerned, the author's studies have led him to the opposite conclusion; and he always expects a frost to break up as soon as the barometer gets much above 30 inches. To test the truth of this theory, he has tabulated the height of the barometer during all the cold periods during the three winter months of the fifty years 1841-90. Out of seventy-four frosts, he found sixteen only had a pressure exceeding 30·20 in.; and the majority of these were of very short duration. Thirty-three, or less than half, had a pressure exceeding 30 inches. Twenty-one had a pressure below 29·80 inches; and these included almost every frost in the period remarkable either for length or intensity. If this general rule is sustainable, it would appear that we have in it one of the most valuable contributions ever made by systematic meteorology to the interpretation of barometrical indications; for there are many human interests to which the power of forming a fairly reliable opinion with regard to the probable duration of a frost is of greater importance than the forecasting of storms.

The Electrical Properties of Flames.

Lord Kelvin and Dr. Magnus Maclean have contributed a paper to the Royal Society of Edinburgh, on the electrical properties of fumes proceeding from flames and incandescent solid fuels. It is observed that many experimenters have investigated this subject by various methods. The present inquiry was confined to testing, by means of a Kelvin and Maclean electric filter, the electric quality of the fumes from different flames and burning fuels; and to ascertaining the effect of such fumes upon conductors. The paper describes the method of experimenting followed, which was applied, among other things, to the flame of a candle, a paraffin lamp, coal gas (bunsen), hydrogen, glowing charcoal, and glowing coals. All the gas-flames, and that of the candles, gave negative electrification. Hydrogen flames appeared to constitute an exception. At low pressure, they gave a small negative; at higher pressure a large positive electrification. No electrification was found from the jet at any pressure when not burning. Both charcoal and coals gave a negative electrification when there was a flame; and both gave positive electrification when they were glowing without flame. This phenomenon was directly contradictory of that noticed by Maclean and Goto in 1889, in the case of an ordinary lucifer match. They found that, while the match was burning with a flame, it gave positive electrification; and after the flame went out, the glowing portion of the match produced negative electrification. No explanation of this difference is offered; but the present paper claims that the results now ascertained are correct. The results obtained, however, are not very regular.

Benzene as an Illuminant.

Benzene, as is well known, is a product of many pyrogenous processes of acetylene. Its discovery by Faraday has had an immense influence on chemical technology; and in thirty years the German coal-tar colour industry has assumed colossal proportions. The German demand for benzene has been chiefly met by England; but the extension of coal distillation in Germany will shortly put her in the position not only to provide for the needs of her own colour industry, and for the carburetting of coal gas, but to have a surplus for disposal. Such was the view recently expressed by Dr. Krämer before a German Industrial Association. The utilization of benzene in other ways has had the learned doctor's attention. He found that, unlike petroleum products (benzoline, &c.), which are very sparingly soluble in alcohol, benzene would mix in all proportions with spirit. An addition of 15 per cent. of benzene to the spirit used in an incandescent spirit-lamp resulted in an economy of fully 25 per cent.—assuming the prices of benzene and spirit to be the same. A mixture of one part benzene and two parts spirit, when burnt in an ordinary petroleum lamp, gave the same illuminating power as petroleum; but at present prices the cost of the mixture consumed would be half as much again as that of petroleum. A considerable rise in the price of petroleum—such as the machinations of the American oil-ring might cause at any time—would bring such a mixture of benzene and spirit into active competition with petroleum.

A Convectionscope and Calorimeter.

A remarkable novelty, in the shape of an instrument for further exploring the physical character of gases, has been brought by Mr. Alfred R. Bennett before the Manchester Literary and Philosophical Society. He calls his appliance a convectionscope and calorimeter. It consists essentially of a glass or metal container, resembling in shape an ordinary glass shade, such as is used to protect clocks, &c., from dust. It contains a vertical tube, not completely extending to the top or the bottom, in which is poised a delicate revolving vane. When by any means—such as exposure to a source of heat—the air inside the container is set in motion, the movement takes the form of convection currents circulating up through the central tube and down the inner surface of the glass, the strength of which is indicated by the revolutions of the vane. Mr. Bennett has already made his device answer many purposes, such as the comparative measurement of specific heats, and determining the relative heat-retaining properties of textile fabrics and other materials. He has also commenced, by its aid, an investigation into the relative sensitiveness of gases to convection. The tests, so far, have revealed several unexpected differences in convection sensitiveness between gases which do not differ widely in their densities, specific heats, or co-efficients of expansion. He has not yet felt justified in giving further particulars of these experiments, because he has not worked with dry gases, and is somewhat suspicious of the effect of moisture upon the results of experiment. Altogether, the possibilities of the new instrument of physical research appear to have a considerable range.

TECHNICAL RECORD.

INSTITUTION OF CIVIL ENGINEERS.

An Engineering Conference.

Arrangements have been made for holding a conference of members of the above-named Institution in London from the 25th to the 27th inst., under conditions which the Council hope may be convenient to many who are precluded from attending the weekly meetings during the session, and may prove serviceable to all by the discussion of a wider range of subjects than can be dealt with on ordinary occasions. It is intended that the business of the conference shall differ from the ordinary proceedings of the Institution in this respect—that papers descriptive of works executed will give place to brief statements concerning important debateable matters in engineering science and practice, introduced with a view to elicit discussion on the questions raised. The morning of each day will be devoted to the consideration of the above statements; and arrangements will be made for the inspection of engineering works in the afternoon. The business of the conference will be carried out under the direction of the Council, with the assistance of seven sectional Committees consisting of members of the Institution representative of various localities in the United Kingdom, and identified with the several branches of engineering. One section will take up the subject of gas, water, and sewerage works; and another will deal with the applications of electricity. The Committee of the former includes Mr. Charles Hunt, Mr. H. E. Jones, Mr. George Livesey, Mr. T. Newbigging, Mr. G. C. Trewby, and Mr. Corbet Woodall, who will represent the gas industry; water engineering being represented by Mr. H. P. Boulnois, Mr. G. F. Deacon, Mr. G. H. Hill, Mr. W. Hunter, Mr. Baldwin Latham, Mr. J. Mansergh, and Mr. T. De Courcy Meade. Mr. Mansergh will preside over the deliberations of this section; the Vice-Chairmen being Messrs. Hill, Boulnois, Deacon, and Livesey. Mr. W. H. Preece, C.B., will be Chairman of the Electricity Section, the Committee of which comprises the principal electricians.

AUTOMATIC GAS STATION GOVERNORS.

The Discussion on Mr. O'Connor's Paper.

In last Tuesday's issue of the "JOURNAL," we published the paper read by Mr. HENRY O'CONNOR, on the above subject, at the meeting of the Society of Engineers the previous evening. A discussion of some length followed, the speakers in which were mostly gentlemen who were particularly interested in the question. The following is a summarized report.

The PRESIDENT (Mr. G. Maxwell Lawford) remarked that Mr. O'Connor had read a most instructive paper on appliances which were of great use to the gas engineer, and in which consumers must be largely interested. The author had illustrated the paper with a series of excellent diagrams; and they could not do less than award him a hearty vote of thanks.

This having been done,

Mr. CHARLES GANDON (Lower Sydenham) was called upon by the President to open the discussion. He said he would obey; but he was afraid he could not add much to what had been stated in the paper. He alluded to the importance of the station governor on a gas-works, and said his principal experience had been with the first and primitive governor referred to by the author, with which he was bound to say he was satisfied under ordinary circumstances. He did not wish for a moment to say that the other types suggested in the paper were not improvements upon that; but it appeared to him they were what one might call theoretical improvements upon those that were actually necessary under ordinary circumstances. If they had a perfectly level district where the gas could be at all times maintained at the same required pressure, then such an apparatus as had been described would be useful; but, unfortunately, all over districts supplied by gas-works, there were variations in the levels, and one had to consider them as well. Therefore, it was a most difficult matter to make an apparatus which automatically adjusted itself to all these different conditions—this had at all events been his experience. He thought the first governor alluded to by the author was a most beautiful apparatus on account of its simplicity. It was like most simple things—they were admirable for that cause; and directly one commenced to complicate them, certain difficulties began to come in. The author had not described what he (Mr. Gandon) had a recollection of, which was a more simple governor still. He had never seen it in action; but he believed it did exist in several places. It was simply a vessel filled with moss, or something of that kind, with a disc of wood, on which weights were put to press the moss closely together. The weights were put on or taken off just as it was desired to regulate the pressure. This was no doubt very simple; but he did not recommend it to gas engineers. (Laughter.) As to the automatic arrangements, it occurred to him that, especially in the case of small works, where one could not have a man constantly watching the pressures in the district, they would be extremely useful; but where they could have a person to attend to this matter day and night, he would rather trust to a man manipulating the original form of governor.

Mr. J. HEPWORTH (Edinburgh) said he was not the inventor of a governor, nor could he claim to have improved governors; but he had had an opportunity of using governors for thirty years, and so had made himself acquainted with the different forms that had been introduced from time to time. He was therefore interested in the historical portion of the paper, and was rather looking for the names of other inventors who had actually made their mark in this direction. He supposed the author would reply that he could not include all the improvements within the scope of a paper. There were such men as Caink, Connolly, Hopper, Elster, Beechey, and others in this country whose names were well known in connection with improvements in station governors. The author had so well illustrated the various forms of governor referred to in the paper that it would seem surplusage for him (Mr. Hepworth) to allude to them especially. But he might say that his recollection was that the second governor described was one invented in France; and he knew that this form was largely used in this country at the present time. For the third one, they were also indebted to a French inventor. It was quite clear that the first *desideratum* in a governor was that it must give an outlet pressure which should not vary, although the inlet pressure did so; and he thought the author had not definitely said in the paper that such a governor now-a-days was available. But one could have a governor which, notwithstanding the varying pressures caused by the weights of the gasholders, would give a uniform pressure at the outlet. This seemed to him to be the first desideratum; and that was not quite reached in the earlier forms of governor to which reference had been made. Then it seemed to him that, having that which was a great step forward in the history and perfection of governors, they wanted something which, if possible, would automatically actuate the pressure; and the author had referred to an interesting invention which was introduced nearly twenty years ago for changing the pressure by clockwork. The clock was made to do, at the right moment, that which the man in charge ought to do, but which he might not do if he was asleep or perhaps half a mile away. This system seemed to be a distinct improvement on governors manually attended to; and, having used it, he could speak of it favourably. The author's object apparently in reading his paper was to bring before their notice a further development towards perfecting the station governor—that was, to give a pressure which should be much more uniform than the pressures given by either the governor attended to by hand or clockwork. He did not know, however, from a cursory glance at the diagrams [exhibited in the room] how far the governor last referred to in the paper secured that end. If it did secure that end—which to him appeared very doubtful—it would be a governor which would serve an excellent purpose, and would meet, he was sure, the approval of many of the gas engineers throughout the country. He (Mr. Hepworth) would like to call attention to a system that had found no place in the paper, and which actually did secure the end that was apparently sought by the governor which was illustrated as the invention of Mr. Milne and Mr. O'Connor. He should not have referred to this, but for the fact that he had worked it himself; and therefore spoke of it from practical experience as being an invention which most satisfactorily accomplished the object aimed at—that was, the regulation and control of the pressure throughout the district supplied with gas. This result was obtained by the automatic variation of the pressure at the station governor at the works, in such a way as to secure a uniform pressure at any part of the district chosen or fixed upon. This had been proposed to be done in two ways. It was first suggested, he thought, that, at the point in the mains in (say) a low-lying district, where the pressure was usually found to be the lowest, a pipe should be carried back from that point to the governor at the gas-works; and the low pressure in this low-lying district was made to carry back the intimation to the works, and itself be the means of loading the station governor with water or of unloading by taking off the water pressure when it was sought to increase or decrease the pressure. It was further proposed—and this was the plan of which he had had some experience—that this should be done by electrical communication; and the system which he had the satisfaction of first using (though not his own invention) worked so well for the time he had it in charge, and continued to do so still, that he was a little surprised it had not found some mention in the paper. It was perhaps not necessary to refer to it more specifically, because there was an article upon it in the "JOURNAL OF GAS LIGHTING" as late as 1893. This system did result in securing an equal pressure at the point of the mains where the pressure was usually the lowest; and therefore secured an equal pressure between the two points—that was, the works and this point of lowest pressure. This, of course, as Mr. O'Connor had pointed out, was one of the things to be aimed at, or, he would say, it was one of the things that already had been accomplished, although the author had not referred to it. The governor Mr. Gandon appreciated so much, and the governor the pressure of which was adjusted by clockwork, only did exactly what they were told; while with the other system, whenever there was a fog in an outlying district, and the pressure went down, the fact was immediately transmitted to the works by an electrical communication attached to the station governor, the governor was loaded with the requisite pressure, and that in the district was

raised at once. He (Mr. Hepworth) thought this was about the last *desideratum* that one could possibly hope to secure in a governor—viz., to regulate the supply of gas in the way he had referred to, and which he had himself found to be thoroughly satisfactory. He was persuaded that the gas engineers of this country would be glad if they could find, either in the system he had referred to, or even in that introduced to them by Mr. O'Connor in the paper, a thoroughly satisfactory method of equalizing the pressure of gas in a district according to the varying circumstances and requirements of the day or night.

Mr. W. Sugg (London) said the first governor described by Mr. O'Connor and the remarks of Mr. Gandon carried him back a good many years, when he was first at the South Metropolitan Gas-Works, and used to regulate the pressure for Greenwich. The governor in use had a large holder, and was of the old Clegg pattern. There was never a great deal of variation in that governor when the pressure of the gasholders changed. One reason for this was that the holder had a very large diameter; and another was that the gasholders were much smaller, and the cupping did not make so much difference in the pressure, or otherwise there might have been some irregularity. No doubt there was a slight irregularity; but that was caused by the pressure of the gas on the cone. As the pressure increased, the density of the gas increased, until it had the effect of lightening the cone to a certain extent. But the diameter of the holder was so large that it made very little difference. So long as a large holder was employed, and they had not a great variation of pressure, then very likely that was all that could be desired. Even with that governor, supposing a cloud came over Greenwich, which he could not see from where he was, he could tell it was there, because he could see the pressure gradually drop, which showed that the quantity of gas allowed to pass through the governor by the weight that was on it was not sufficient, and then he had to put on another weight. Since the time he was speaking of, there had been an immense alteration in the quantity of gas required, in the size of the holders of the governors, and also in the amount of variation in the pressures of the large gasholders. They might run up something like from 6 inches to 9, 10, 11, or even 12 inches. The effect upon a governor such as the one described by the author would be, where they had a variation from 6 up to 9, 11, or 12 inches, that the density of the gas would be so much greater that the weight of the cone would be lightened; and it would cause the pressure to fall. He did not know whether he was right in supposing that the tubes in this new governor were to equalize that pressure, because he saw there was only one cone. He did not think such an arrangement as that was suitable for any but small towns, because (say) in London the demand was so extremely changeable from day to day, and from hour to hour, that he did not think it would be possible to regulate the pressure to satisfy everybody. He thought the pressure would have to be much increased, to keep it always sufficient at the lowest point of the district. Gas stoves and incandescent burners required at least an inch pressure. Therefore they would always have to keep 1 or 1¼ inch pressure at the lowest point; and at the higher points, if the pressure rose much, the only way to regulate it would be to put a governor on at the consumers' own houses. In hilly districts, if the governor was in a low situation, then the gas ran up to the highest points; and there a much greater pressure obtained than at the governer. In the case of Folkestone, for example, the elevation was greatest at the Lees; and the consequence was the gas used to rush from the works at the lower part of the town up the Lees, so that they could never get any pressure in the principal part of the town. This was stopped by putting a dry governor underground to regulate the pressure at the Lees; and it reduced it to 1½ inches. He did not think the governor described was meant for such a case as that. [Mr. O'Connor: No.] Having described an ingenious method invented by M. Giraud for regulating the pressure in a district, he referred to the use of the double cone. The regulation of the lower cone, he remarked, was an awkward job, because when one of them was up on its seat, the other had to be up on its seat at the same time, and that could not always be done. When the cone of a governor was near its seat, a slight alteration of the pressure would cause it to go right up, and stop the gas. The best way to get over that was to have a bye-pass governor on the lower part of the governor. The bye-pass would do all the work in the day; and the other would come into action by itself. This had been carried out; and it seemed to answer very well. Mr. O'Connor's arrangement certainly seemed very ingenious.

Mr. J. L. Cloudsley (London) having remarked that he had been much interested in Mr. O'Connor's historical record of the governor question, said he should like to allude to Mr. Sugg's difficulty, which was at one time a very real one. Mr. O'Connor had referred to the double-cone governor which was intended to deal with the difficulty of changes in the pressure; and no doubt it had that effect. But being a double-beat valve, it brought about another difficulty—that it increased the area of the valve; and consequently did not control the gas as a single-beat valve would. In designing a governor for (say) a 24-inch main, he thought it had been found that, for an average gas-works, the seat of the valve should only be about half the area of the pipe. It was familiar to gas engineers that gas would pass more easily through the knife-edge of a valve than it would through a short length of pipe. He had no doubt some gentlemen present had, in opening a valve from a gasholder, been surprised at the large quantity of gas that would go through a small opening. Passing to the apparatus Mr. O'Connor had so well described—the automatic arrangement of his own and Mr. Milne's, by which he proposed to maintain the pressure of the district—Mr. O'Connor and other gentlemen present knew quite well that that was not a new idea. The first arrangement of the kind was that of a Mr. Keeling, who was the Manager of the Reading Gas-Works about forty years ago. He had a small water vessel attached to the end of the counterbalance chain, and connected by a tube to a stationary vessel. As the governor fell, the water passed from the one vessel into the other. But this was not satisfactory; and it failed for various reasons. Mr. Connolly, of New York, and several others in this country, had attempted the same thing; but he doubted if they had succeeded over others, as there was one fatal defect which he did not think Mr. O'Connor had anticipated, and that was that the changing of the inlet pressures would alter the position of the bell, according to the opening of the valve. That was to say, should the valve be opened to any considerable extent, and the inlet pressures changed (say) from 6 to 10 inches, there would be a considerable unshipping of the water, and consequently a considerable falling of the outlet pressure. Unless this could be provided for by an attendant who was at hand, it would lead to serious consequences. He knew that, in the case of several kindred arrangements to the one under notice which he had had an opportunity of testing, this had been a prominent difficulty which had always blocked the way.

Mr. W. Worby Beaumont said the system referred to by Mr. Hepworth seemed to one who was not intimately acquainted with governors to offer a means of working very advantageously, with the exception that it involved a different set of apparatus altogether at a considerable distance, and the burying of the electric wires. Mr. Hepworth might have told them a little more as to the nature of the apparatus that the current worked at either end of the wire. He did not gather how it was that the alteration of the pressure at one end caused the uniformity at the other. One point that struck him in Mr. Sugg's remarks was as to the effect of the variation in the density of gas through the very small variations in pressure that ordinarily, as he took it, occurred. It was interesting to know that that variation in density was sufficient to make a variation in the action of the governor. [Mr. Sugg: It lightens the cone.] When one remembered that coal gas, at ordinary pressures, had such an exceedingly small density—roughly, he supposed about half that of atmospheric air—it seemed remarkable that these things should be so sensitive. That that slight difference in the density should make a difference in the flotative power of the bell caused one to wonder whether it would be possible to make use of that by constructing a bell of light material, and perfectly gas-tight, so as to get one of exceedingly great flotative power, and use it as a means of governing.

Mr. F. W. Cross (Lea Bridge) said the only point that had particularly struck him was as to how the governor last described by the author was affected by the inlet pressure, by the variations of pressure produced by the uncupping or cupping of the holders, or by the changing of the holders. Gas managers experienced a great deal of trouble from those causes, if they had not a governor sufficiently sensitive to regulate them. It appeared to him, from the paper and illustrations, that the syphon-tubes were supposed to regulate the sudden differences of pressure; but he should like to know if the syphon-tubes were sufficiently quick in their action to counteract the differences in pressure. It was not, of course, in the nature of things that gas managers could have experience of many kinds of governors. The author said that gas managers did not study the laws of pressure; but they did to an extent when they had to put in a new governor. They had to study the new governors with the view of economy and greater satisfaction to the consumers, and their own comfort. One new governor of which he had had experience, and had put into position and started to work, was not mentioned in the paper. It was one of Cowan's equilibrium governors, which he put in while at Hong Kong, and which he severely tested. He had two separate mains leading from the governor-house. The outlet of one governor was connected to another; one governor only being used when the demand necessitated it. One evening when the pressure was full on the small governor, he suddenly opened the valve of the other governor, so that the two mains were filled with gas direct from the holder; and there was not the slightest variation on the pressure changer. He thought that would not be so with the new governor described by Mr. O'Connor—its action would not be sufficiently quick to counteract the sudden increase of pressure. The author had alluded to the equilibrium of the pressure all over the district; but that must be only "the dream of the gas manager," for the districts varied so greatly in their levels. Extensions of the boundaries frequently took place, business and trade expanded, mains became too small, and in many other ways changes occurred. He again referred to his interesting experiences in Hong Kong, to the great variations in the levels there, and to his successful employment of dry governors.*

Mr. Hepworth, complying with Mr. Worby Beaumont's

* See "Journal," Vol. LXVI., p. 16.

request for further information concerning the electrical system of governing pressures, read a description of it from the article on the subject which appeared in the number of the "JOURNAL" for May 16, 1893, entitled "Constant District Pressure Automatically Maintained."

Mr. O'CONNOR, replying to the discussion, said Mr. Gandon had pointed out that the pressure of gas should be maintained sufficiently to supply consumers at the most remote position from the gas-works; and he seemed to think that the old form of governor first described would practically answer that purpose. But there had been many accidents with old pattern governors; and they did not, as subsequent speakers mentioned, give any means of putting the two valves in equilibrium. He thought this was the principal reason why there were not many of them made at the present time. He was afraid he must attribute to his rapid reading the fact that many gentlemen had not quite mastered the end and aim of the arrangement which he had proposed towards the end of the paper. As Mr. Hepworth had said, he had found it quite impossible to mention anything like the whole of the governors that had been invented; but he had taken from among those he knew of some which were perhaps most commonly used in different parts of the country, and which contained simple points which led forward to one end. He had heard many times of the arrangement suggested by Mr. Hepworth; and he had heard it spoken of very adversely. It always required a considerable amount of electrical power to open or shut a cock. This seemed to him to be a very great objection to such a method, in addition to the fact pointed out by Mr. Beaumont that the wires would have to be laid a long distance. This would not only entail great cost, but there was the likelihood of the current passing to earth if any abrasion took place on the coating of the wire before it arrived at the works, and actuated the mechanism. If they were waiting and expecting this piece of apparatus to do its work automatically, and something went wrong, they would not be able nearly so readily to correct the error as they would be if it was an apparatus that required daily and constant supervision. Then, as to the question of laying a special pipe from the portion of the district (which would probably be the most distant point) where the pressure would be the lowest, to inform those at the works what was being done there, that would be going to an enormous expense; and probably there would be lost, by leakage, a considerable amount of the pressure placed in that main at the other end. He was afraid Mr. Sugg had not quite mastered the idea for which he was proposing to use the new governor. It was for the purpose of increasing the outlet pressure when the quantity of gas going out from the works was increased, and so allowing a larger quantity of gas to pass through the mains to where the pressure was at its lowest, to enable the consumer there to have sufficient pressure to get light or heat as he required it at all times of the day or night, no matter what consumption was going on between himself and the works. Then Mr. Sugg had mentioned the use of pressure reducers in the district. He (Mr. O'Connor) would like to know the size of the diaphragm governor he referred to as having been employed at Folkestone. He was not aware before that they were used of any size much above 3 or 4 inches.

Mr. SUGG: The governor employed there was 2 ft. 6 in. in diameter; and the main was an 8-inch one. It was put down by Mr. Barlow, so that was a long while ago.

Mr. O'CONNOR pointed out that there were dozens of governors that would answer the same object. Mr. Worby Beaumont had spoken of the "density" of the gas, which was an expression used by Mr. Sugg; but he thought the latter gentleman was speaking of the pressure at which the gas was standing inside the governor. [Mr. SUGG: Around the governor valve.] As to the question mentioned by Mr. Cross regarding the methods for making what was commonly known as an equilibrium governor, he had not shown that on his diagrams. The new governor could be fitted to anyone of the systems—either the double cone, or the secondary chamber, or that made by Messrs. Cowan, or any other form—which regulated the pressure in the matter of equilibrium; it was only a question of adding them to it. Then as to the tubes being large enough for allowing the water to get in and out rapidly, they were purposely made so that the water could not get away too rapidly. If the water syphoned itself over at a rapid rate in these particular syphon tubes, then the moment the governor fell or rose, the water would rapidly syphon out, and consequently make the pressure vary. It was not intended to utilize this as an equilibrium governor, but to deal with the outlet pressures. As to vastly hilly grounds, special methods were required for the purpose of overcoming the peculiar circumstances in each case.

Lithium Carbide.—Lithium has a much stronger affinity than the majority of metals for carbon; and the carbide is formed on heating the metal in most compounds containing carbon. The carbide is freely produced when lithium is heated in carbonic oxide or carbonic acid. Ethylene is completely decomposed at 1300° Fahr. by lithium, and the carbide and hydride of lithium are formed. Güntz has found that if acetylene is suddenly introduced to lithium heated in a vacuum, the same compounds are formed, and very little carbon is separated. Methane, on the other hand, yields very small quantities of the carbide and hydride.

REGISTER OF PATENTS.

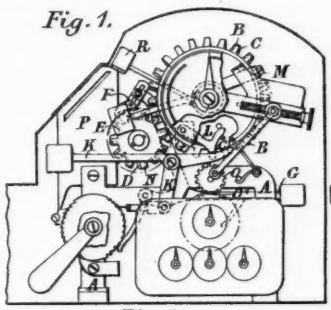
Gas Motor-Engines.—Lanchester, F. W., of Alvechurch. No. 7603; April 10, 1896.

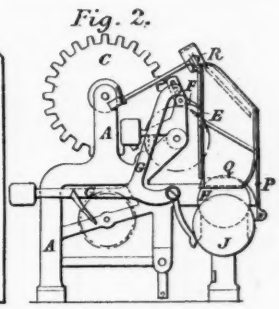
This invention has for its object "the construction of a motor in which the reciprocating and other moving parts are perfectly balanced, and in which the turning moment due to the recoil consequent on each explosion . . . is taken up by the moving parts of the motor, and is not transmitted to the structure to which it is attached."

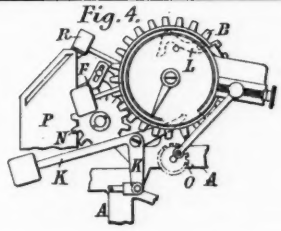
When employing gas or oil vapour as a source of motive power, both exhaust and feed are preferably arranged to take place through a single valve of the mushroom type, whose stem lies in or about the axis of rotation; and distributing parts are arranged in the journals opening into a chamber beneath the valve, to control the respective functions of the different portions of the cycle. In arranging to work on the Otto cycle, the external frame is made of elliptical form; so that the pistons perform two strokes for one revolution, and there is on the frame a cam to operate the valve opening into the motor cylinder. Thus the turning force is exerted between the external frame and rotating cylinder, and no unbalanced turning moment will act on the structure to which the engine is attached, so that the frame and cylinder will spin round in reverse directions. These two rotating elements may be arranged to do work independently, as when a set of fan blades or propeller blades is attached to each; but they may be so coupled by gearing that the whole power may be taken from either element. In this latter arrangement, a certain turning moment will be transmitted to the structure through which the gearing is effected; but this will be a uniform moment for any given load, and not a series of impulses, as is the case in motors of the ordinary type. In another plan, the frame is prevented from rotating by a spring connection with the structure on which the motor is carried. In this arrangement, an approximately constant turning moment is imparted to the supporting structure; the frame having temporary rotary movement imparted to it at each impulse of the motor cylinder.

Prepayment Gas-Meters.—Willey, H. A., and Simpson, S., of Exeter. No. 9233; May 1, 1896.

This invention relates to mechanism for use in connection with gas, electricity, and other prepayment meters, more particularly of the kind described in patent No. 7991 of 1893, wherein differential wheels geared together through spring-connected pinions are employed, one of which wheels is adapted to be moved through a predetermined angle in one direction, by means of an external handle through the medium of each coin inserted, while the other (the measuring) wheel is adapted to be moved in the reverse direction by the operation of the meter, and, being geared with the first wheel, simultaneously effects its return movement at a different rate of speed.







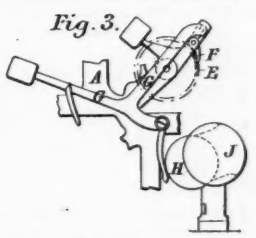


Fig. 1 is a front elevation of the prepayment mechanism; the casing being shown in section. Fig. 2 is a rear elevation; showing the parts in the position they occupy when the shut-off valve is closed. Fig. 3 is a rear elevation of the mechanism; the parts being shown in the position they occupy while the mechanism is being set by means of a coin. Fig. 4 is a front elevation of the mechanism; the parts being shown in the position they occupy after the mechanism has been set.

A is the frame of the prepayment-mechanism; and B C are the differential gear-wheels, of which B is the measuring-wheel, and C the wheel which is moved relatively to the measuring-wheel when the mechanism is set by means of a coin. The wheel C is moved to set the mechanism by means of a pinion D geared therewith, and turning on a stud mounted on the frame A, and to which pinion is rigidly secured a ratchet-wheel E. This wheel is operated through a pawl F, pivotally mounted on a weighted arm or lever, which turns freely on a stud, and normally rests on a projection on the frame A, as indicated in Fig. 2. The pawl F is provided with a slotted extension, in the slot of which works a pin fixed in one arm of a weighted lever G. This lever turns about a pivot, and is provided with an arm or extension against which the coin H, projecting from the rotary coin-pocket J, will act, as shown in fig. 3, when the coin-pocket is turned about its axis. The coin-pocket, mounted on an arbor, is provided with a handle for operating it, and also with a ratchet-wheel controlled by a pawl, to prevent the turning back of the pocket after the coin has once acted upon the extension of the lever G to set the prepayment mechanism.

The shut-off valve of the meter (not shown) is connected to a weighted

bell-crank lever K, pivoted to the frame A, and provided with an arm or extension in such a manner that the valve remains open, except when closed by the depression of the arm, as hereafter described. L is a cam-piece, pivotally attached to the measuring-wheel B on the side adjacent to the wheel C. The arm of the lever K extends into the path of the cam-piece L; and a pin is fixed in the wheel C, and is so arranged relatively to the cam-piece that, in all positions except when the index-pointer is at or near zero, the cam-piece L will yield freely when passing over the extension. When, however, the pointer has almost arrived at zero, the free end of the cam-piece L will be pressed against a pin on the wheel B, by means of a pin (as shown in fig. 1), so that the cam-piece L is rigidly held in position, and, on the further rotation of the measuring-wheel, will depress the arm, and thereby gradually close the valve and cut off the gas—previously giving warning to the consumer, by the lowering of the light, that the supply is about to be cut off.

In order that the wheel C, after being turned about its axis relatively to the wheel B through the medium of a coin, shall be returned to its original position by the meter-mechanism, the wheel B is provided with a projecting flange or surface with which engages a "silent-feed" clutch M, mounted on a balanced frame turning freely on the sleeve of the wheel B. The frame is turned about its axis alternately in either direction, through the medium of a link, crank-pin, and gear-wheels O, O^1 driven by the mechanism as the gas passes through the meter. The link is connected to the frame by an adjustable pivot, so as to enable the travel of the clutch M to be varied in accordance with the price of gas. A spring clutch is attached to the frame A, and engages with the flange of the wheel B, so that the latter can only be turned in one direction. The number of teeth on the wheel B is greater than the number on C (the former having one more tooth than the latter in the arrangement shown); and the wheel B is geared with a pinion N, having the same number of teeth as the pinion D, and mounted adjacent thereto—the pinion N being provided with a spring-pawl engaging with a toothed wheel fixed on the pinion D. By these means, when the wheel B is rotated by the meter-mechanism through the "silent-feed" above described, the wheel C is turned through a greater angle than the wheel B, until the index-pointer is finally returned to zero on the dial, and the main-valve of the meter is closed by the cam L and lever K, as described. While, however, the wheel C is being set by means of a coin, the wheel B and pinion N are locked; and the pinion D and wheel C can therefore rotate while the pinion N and wheel B remain stationary.

The coin-shoot P is made with a pivoted or rocking side-wall Q, provided at its upper end with a lip extending into a slot in the opposite side-wall of the shoot. The wall Q is made of such form and dimensions that, when the upper end of the shoot is open to permit the introduction of a coin, the lower part will be closed by the lower end of Q; and, when the lower end of the shoot is opened by the rocking of the wall Q to allow the coin to fall into the coin-pocket J, the upper end will be closed by the lip entering the slot.

To prevent the further introduction of coins after the wheel C has been displaced through nearly a complete revolution relatively to the wheel B, there is a weighted lever R, bearing a hook or catch, and fixed on an arbor mounted in bearings on the frame A. At the other end of the arbor, is mounted an arm or projection adapted to engage with a disc sliding freely on a stud. The disc is provided with a pin, extending through an aperture in the wheel C, and adapted to engage with an incline or projection on the wheel B when the amount of gas prepaid has reached its maximum value—that is, when the wheel C has been turned through nearly a revolution relatively to the wheel B. When the projection engages with the pin, it forces the disc away from the wheel C, and causes the arbor to be turned about its axis, so as to bring the catch into engagement with the upper edge of the rocking side-wall Q of the shoot, and thus prevents the introduction of any additional coin until, by the action of the meter mechanism, the projection has been moved out of engagement with the pin.

Incandescence Bodies for Gas-Burners.—Nicholls, W., of Holborn, W.C. No. 9244; May 1, 1896.

The patentee proposes to use, as his impregnating solution, a mixture of 250 parts of zirconium nitrate, 100 parts of calcium chlorate, 160 parts of ammonium nitrate, and 5 parts of uranium nitrate. The mantle (made of any suitable fabric to the desired form) is saturated in an aqueous solution made according to this formula, and dried in the ordinary manner. The first application of a flame consumes the fibrous constituent, and leaves only the frame or skeleton of metallic oxides remaining.

Incandescence Gas-Burners.—Denayrouze, L., of Neuilly, France. No. 12,874; June 11, 1896.

This invention—relating to burners in which the combustion of an intimate mixture of gas and air is employed to heat a mantle or other suitable appliance giving light by incandescence—refers to "a simple

Fig. 1.

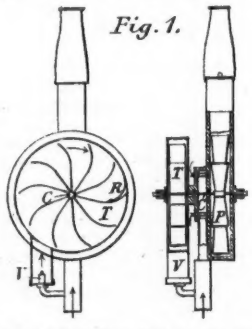
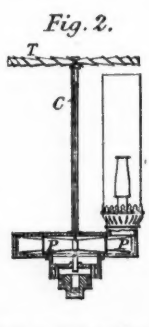


Fig. 2.



application of heat (either that of the products of combustion or that of a separate flame), to work apparatus for feeding the air and thoroughly mixing it with the gas."

Fig. 1 shows vertical sections (at right angles to each other) of one form of apparatus, in which the movement is obtained from a flame separate from that of the burner. Fig. 2 shows apparatus in which the movement is obtained from the heat of the burner flame.

At the side of the lower part of the lamp in fig. 1 is mounted on a horizontal axis C a wheel T, having curved blades; and under this wheel, a little at one side, is a small gas-jet V, the ascending products of combustion from which cause the wheel to revolve. In order to regulate its speed, a light spring R, carrying at its end a rubber, is attached to one of the blades, so as to bear with certain friction on the interior of the wheel case, and act as a brake. On the axis C is fixed the fan P, by which the gas and air supplying the flame are thoroughly mixed.

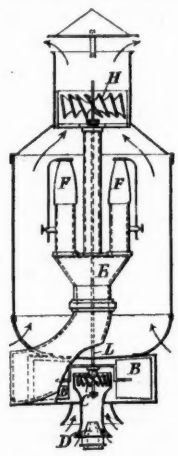
In fig. 2 the axis C is vertical, and has at its upper end the wheel T, made with inclined blades, on which act the products of combustion ascending from the lamp-flame; causing the wheel T and the mixing-fan P to revolve.

Incandescence Gas-Lights.—M'Donald, A., of Brodick, and Paterson, A., of Glasgow. No. 13,060; June 13, 1896.

This invention has for its objects: To obtain a more complete and uniform incandescence of the mantles of incandescence gas-lights, to prevent the mantles from being injured by fluctuations of the air or gas currents, and to allow of the satisfactory use of rich gas without smoking or depositing carbon. These objects are effected by the provision of means for controlling the admission of air to the space between the exterior of the mantle and the chimney, combined with means for controlling the air-admission to the interior of the burner-tube.

Incandescent Gas-Lamps.—Denayrouze, M. L., of Neuilly, France, No. 14,281; June 27, 1896.

This invention relates to the construction of an incandescent gas-lamp in such a manner as to utilize the energy of the gas supply, the draught of the chimney, and the power of a jack wheel mounted in the chimney, for "effecting the supply of air and intimately mixing it with the gas, so as to obtain very hot bunsen flames for heating the mantles."



For this purpose, on a hollow base E two or more burners are arranged, with their mantles F within a glass cylinder or globe, in the centre of which, between the burners, is mounted a vertical spindle L. On this spindle, in a chimney above the roof of the cylinder, is fixed a jack wheel H having inclined blades, which are caused to revolve by the upward current of the products of combustion. In a casing below the burners are fixed, on the central spindle, another jack wheel C, with inclined blades; and also above it a fan with blades B. The gas admitted at D, along with a portion of the air drawn in by it through lateral openings, playing upon the jack wheel C below, tends to turn it, and thus aid the jack wheel H in the chimney above. The fan B, driven by both wheels, draws in a further supply of air; and, mixing it intimately with the gas and air drawn in below, sends the mixture into the chamber E, from which it passes by branches to the burners—these receiving a further supply of air for combustion, drawn in laterally from below the globe.

Alluding to his proposal, the patentee says: "By the arrangement described, I utilize three existing but weak sources of power—the inflow of the gas, the heat of the combustion, and the draught of a chimney as little inconvenient as possible. I thus, at no expense of power, obtain the effects which characterize my previous inventions, which may be thus summarized: It is only of the gas and air—that is to say, the elements at present imperfectly utilized of luminous combustion—that I require automatic production of the mixture which gives the highest efficiency under an incandescent mantle; the mechanical work for forming this mixture being borrowed from three weak sources of power, the latent energy of which, hitherto wasted, is at once brought into action by the combustion."

Igniting Device for Gas-Lamps.—Schmidt, E., of Berlin, No. 15,861; July 17, 1896.

In the drawings attached to the specification of this patent, the automatic igniting apparatus is shown in connection with an ordinary incandescent lamp. It consists of an electro-magnet having an armature composed of two independently moveable members; a gas-cock operatively connected to one member, and an igniting device connected to the other member; and means for sending one and the same current through the electro-magnetic coils and to the spark-producing device. The means for operatively connecting one armature member to the gas-cock consists of a double pawl, suspended from the armature and adapted to engage alternately pins on the cock (which is revolvable); and a spring attached to the gas-cock, and rotated therewith—the spring being connected to the double pawl and operating it.

Gas-Lamps.—Cowan, T. W., of Rotherham. No. 23,616; Oct. 23, 1896.

The object of this invention is to provide a self-contained wind and rain proof shadowless gas-lamp (with provision for feeding the pilot-lights without extraneous or exposed bye-pass tubes), especially adapted for use with groups of incandescent burners, arranged around a central gas-chamber so that the flames appear to coalesce when (say) three or more are used. The gas-chamber is fed by a central gas-tube, so formed that it carries both the storm case and the glass shade or frame. The latter is spherical or oval or other preferred shape, provided with a straight shoulder at the mouth, and is designed to cast a vertical beam of light downwards when desired, by shaping the lower outer surface in prismoidal zones.

APPLICATIONS FOR LETTERS PATENT.

10,320.—Sheftel, M., "Manufacture and production of bodies for use as filaments in electric incandescent lamps, or for making hoods or mantles for incandescent gas lighting, or for like purposes." April 26.

10,321.—Dvorkovitz, P., and Sheftel, M., "Manufacture and production of mantles or hoods, and other incandescing bodies, for lighting purposes." April 26.

10,348.—Towlson, E., and Andrew, T., "Steam or gas engines." April 26.

10,371.—Stephenson, A. A., "Method and composition for making gas." April 26.

10,423.—Clinch-Jones, F. J., "Gas-producers." April 27.

10,433.—Thomson, J., "Mechanism for controlling the action of oscillating discs, particularly applicable to disc water-meters." April 27.

10,494.—Borrodaile, L. L., "Electric gas-lighters." April 27.

10,501.—Feldmann, A., "Removing carbonic acid and hydrogen sulphide from ammoniacal liquor." April 27.

10,508.—Evans, E., "Generating acetylene gas." April 27.

10,577.—Marks, G. C., "Triple action apparatus for the recovery of benzols or other products contained in certain gases." A communication from La Compagnie pour la Fabrication des Compteurs et Matériels d'Usines à Gaz. April 28.

10,645.—Main, R. B. & A. P., "Burners for gas-grills." April 29.

10,662.—Simpson, S., "Dry gas-meters." April 29.

10,686.—Patterson, J. J., "Generating acetylene gas." April 29.

10,806.—Eves, J. V., O'Brien, W. D. & L. F., and Cleaver, J. F., "Gas-heated smoothing-irons." April 30.

10,807.—Harlow, W., and Warwick, H., "Combination of cooking-range boiler and gas-stove." April 30.

10,825.—Bower, A. S. & G., "Combined process for the protection of iron and steel surfaces from rust, and for the manufacture of combustible gas." May 1.

10,911.—Quentin, A. A., "Carburetting air." May 1.

Leeds Water-Works Improvements.—For the purpose of extending their works, the Leeds Corporation Water Committee have entered into arrangements to purchase land and premises at Thruscross, Fewston, at a total cost of £3900.

The Public Lighting of Wells.—The Wells Town Council yesterday week had before them reports from the Lighting and the General Purposes Committee, giving full details and an estimate of the cost for an installation of the electric light for the city (amounting to £7957), and recommending that the Gas Company be asked to give prices for lighting the city under different schemes. This information is contained in a letter from the Company received that morning. They offered to light the city with the incandescent light for longer hours than at present for the inclusive sum of £350 per annum for three years; the present charge being £450. A good deal of discussion ensued, throughout which a tone of satisfaction with the offer pervaded the Council; and ultimately it was accepted. The Council will, however, retain their electric lighting powers, so that they may adopt the light at the end of three years if they deem it desirable.

Incandescent Gas Lighting for Kingston-on-Thames.—The Kingston-on-Thames Gas Company have amended a previous offer to the Corporation to light the gas-lamps in the borough on the incandescent system. They are prepared to fit up with the "Kingston" pattern lantern (doing away with the old lantern and cradle), and to supply and fit incandescent burners free of cost to all the lamps as now lighted throughout the borough for a term of three years from Sept. 29 next, for the sum of £3 7s. 6d. per lamp per annum, to include lighting, maintaining, cleaning, and extinguishing, and painting once a year. The Lighting Committee have passed a resolution (which the Council have approved) to the effect that the Company be informed that the Committee will be prepared to recommend these terms to the Council, subject to the modification that, instead of the arrangement applying to all the lamps now lighted, it should be made binding on the Corporation for a period of three years in regard to the minimum number of 500 lamps; leaving the Corporation at liberty to light electrically such of the remaining 124 lamps in the borough as they may see fit.

Gas-Works Improvements at Darlington.—Last Tuesday, Colonel J. O. Hasted sat at the Town Hall, Darlington, to hear evidence as to an application by the Corporation to the Local Government Board for sanction to the borrowing of £30,000 for gas-works purposes. A statement was made by the Borough Accountant (Mr. J. W. Armitage), which showed that the cost of the gas-works up Dec. 31 last amounted to £105,268, of which £75,000 had been paid off, leaving outstanding a liability of £30,267. The profit, after paying interest and liquidation, for the past year amounted to £3433. The profits contributed in aid of the rates from 1892 to December, 1896, had reached £13,055, with an average per annum of £2611. The estimated amount to be handed over from the Gas Department for the year ending March, 1898, was £5884, which was equal to a rate of 8½d. in the pound. The total amount of the rates in the borough was 4s. 6d. in the pound; and the price of gas was 2s. per 1000 cubic feet. The Borough Surveyor (Mr. T. Smith) described the proposed new works, and submitted plans. The present plant, he said, was laid down to produce 600,000 cubic feet of gas per day; but they were actually turning out about 1¼ million cubic feet. There was no opposition; and Colonel Hasted made an inspection of the works.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

The Fox Water-Gas Libel Case.

Sir,—My attention has been called to-day, for the first time, to the following paragraph from the report, in your issue of the 6th of April, of the evidence of Mr. Samson Fox in the case of *Fox v. Jerome*: "Water gas had been a commercial success where it had been intelligently applied to the right sort of work. Asked if he could give the name of any man besides himself who had made £50,000 out of it, he mentioned Mr. Andrew Stewart, of Glasgow, the largest tube maker in this country." To prevent misunderstanding, I wish to state that the suggestion that I have made £50,000 out of water gas is wholly unfounded. I may add that neither I nor any member of my family has directly or indirectly been at any time connected with any water-gas company or syndicate.

Glasgow, May 7, 1897. Andrew Stewart.

Recovery of Water-Rates by Statutory Companies.

Sir,—Having just had a little experience in the recovery of water-rates summarily in our Police Court, and having been met by what appears to me to be a strange and unwarranted ruling by the Magistrates' Clerk, I beg the favour of a little space in the "Journal" for ventilating what is, I think, a very important matter to all water companies who may have occasion to recover rates in a Court of Summary Jurisdiction.

The claim in question was in respect of a supply of water to two houses, the rates for which were "farmed" by the landlord, and comprised three quarters' water-rates and the cost of some water-fittings. The Magistrates' Clerk held that we could not recover for any period over six months from the date of demand; and he cited the case tried in 1894 of the *East London Water-Works Company v. Charles** in support of his ruling. I submitted that this case referred only to a "tenant's" supply, and that our claim, being for a "landlord's" supply, should be governed by the Water Companies (Regulation of Powers) Act, 1887. I also stated that I had authority for saying that the East London Water Company claimed for landlords' supplies in the Mayor's Court without restriction; to which the Clerk replied that the Mayor's Court was not a Police Court. As a result, I obtained judgment for that part of the claim only which came within the six months' limit.

I shall be glad to learn from managers and others who have had similar claims in a Police Court, if they have been met in the same way; and, if not, whether they recover summarily for over six months' rates. This, I submit, is a matter of great importance to all statutory water companies, as, if it is a sound ruling, the Regulation of Powers Act is nothing short of a "taking away of powers Act," and is of but little use to us, because, having deprived us of the power to cut off the supply, it leaves us that much worse off than in the case of an ordinary tenant. I may add that this Company have a Provisional Order with which the Water-Works Clauses Acts are incorporated. I trust some of your numerous readers will be pleased to give me the benefit of their experience and advice.

Blaenavon (Mon.) Gas and Water Works, May 7, 1897. C. White, *Manager.*

The Cost of Electric Lighting in Country Houses.

Sir,—With reference to your comments, in the "Journal" for the 27th ult., on my letter to the "Electrical Review" *re* "Country House Lighting," the costs of the installations were about £325 and £140 respectively; the former having really more plant than was necessary, as they only charge cells about 14 hours a week in winter, and about 5 hours a week in summer. The cost of running, excluding lamps, oil, and gas, mentioned in my letter, is under 1 per cent. per annum for the larger plant, which includes a new commutator on the dynamo just put on, making it after five years' working as good as it was when new. On the smaller plant, I have myself done what little jobs required doing, and have not kept account of them. I should think, however, 1 per cent. per annum would cover them.

Since writing the letter to the "Electrical Review," I am told that the single item of cleaning muslin curtains in the windows has been reduced upwards of a sovereign a year, since the electric light was installed. This must also greatly prolong their life. There are numerous other savings of small amounts, which added together soon show a substantial interest on the money expended in plant, besides saving a lot of work in cleaning in a house, especially as regards ornamental metal work.

Bradford, May 7, 1897. Percy Rosling.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills:—

Bills brought from the Commons, read the first time, and referred to the Examiners: Arundel Gas Bill, Devonport Water Bill, Luton Water Bill, Pwllheli Corporation Bill, Tuxford and District Gas Bill.

Bills read the first time, and referred to the Examiners: Gas Orders Confirmation Bill (No. 1), to confirm Provisional Orders relating to Hoylake and West Kirby, Killamarsh, Sedbergh, and Westbury; Gas Orders Confirmation Bill (No. 2), to confirm Provisional Orders relating to Cradley Heath, Harrogate, Market Harborough, and Wimborne Minster; Water Orders Confirmation Bill, to confirm Provisional Orders relating to Barton-upon-Humber, Bridge of Allan, Frith Hill (with Godalming and Farncombe), Gosport, Newmarket, Royston, and Steyning Districts; Paisley Water-Works Provisional Order Bill.

Bills read a second time and committed: Chichester Corporation Water Bill, Crowborough District Water Bill, Edinburgh Corporation Bill, Leeds Corporation Bill, Perth Improvements Bill.

* See "Journal," Vol. LXIV., p. 196.

Bill reported: Edinburgh Corporation Bill.

Bills read the third time and passed: Carnarvon Corporation Bill, Dumfries and Maxwelltown Water Bill, Huddersfield Corporation Bill.

Petitions have been presented against the Crowborough District Water Bill and the Dublin Corporation Bill.

The Stirling Burgh (Gas) Bill has been referred to a Select Committee, consisting of Lord Hawkesbury (Chairman), Lord Barnard, Lord Napier, Lord Chelmsford, and Lord Shute; to meet on Tuesday, May 11.

The Belfast Water Bill and the Leeds Corporation Bill have been referred to a Select Committee, consisting of Lord Clinton (Chairman), the Earl of Malmesbury, Lord Calthorpe, Lord Carew, and Lord Stanmore; to meet on Thursday, May 13.

HOUSE OF COMMONS.

The following progress has been made with Bills:—

Bills read the first time, and referred to the Examiners: Carnarvon Corporation Bill, Cirencester Water Bill, Duntocher and Dalmuir Water Provisional Order Bill.

Bills read a second time and committed: Newhaven and Seaford Water Bill, Southwark and Vauxhall Water Bill, Tynemouth Corporation Water Bill.

Bills reported: Clackmannan Water Supply Provisional Order Bill, Cowes Gas Bill, Loughborough Corporation Bill, Paisley Water-Works Provisional Order Bill, Taunton Gas Bill, Torquay Corporation Water Bill, Tynemouth Gas Bill.

Bills read the third time and passed: Clackmannan Water Supply Provisional Order Bill, Paisley Water-Works Provisional Order Bill.

The East London Water Bill, the New River Company Bill, and the Southwark and Vauxhall Water Bill have been referred to a Select Committee, consisting of Mr. Rankin (Chairman), Sir J. Joicey, Mr. Muntz, and Mr. J. H. Maden; to meet on Monday, May 10.

The Lowestoft Water and Gas Bill, the Malvern Link Urban District Gas Bill, the Newport Corporation Bill, the St. Anne's-on-the-Sea Gas Bill, the St. Neot's Water Bill, the Swadlincote District Gas Bill, and the Weymouth Water Bill have been referred to a Select Committee, consisting of Colonel Gunter (Chairman), Mr. J. A. Pease, Mr. A. Brassey, and Sir Weetman Pearson; to meet on Tuesday, May 11.

Mr. S. Woods has placed on the paper a notice of a motion for next Thursday that it be an Instruction to the Select Committee on the East London Water Bill "to insert a clause compelling the Company to treat the ratepayers outside the Metropolitan area similarly to those within that area in regard to a constant supply of water;" and Mr. Ernest Gray will on the same day move a further Instruction to insert a clause providing that the term "the annual value of the tenement supplied with water" shall have the same meaning in the districts supplied by the Company outside the Metropolis as the term now has within the Metropolitan area.

HOUSE OF COMMONS COMMITTEE.

Tuesday, April 27.

(*Before Mr.* J. A. Campbell, *Chairman, Mr.* Baird, *Mr.* Lough, *and Mr.* Colville.)

NOTTINGHAM CORPORATION WATER BILL.

The proceedings on this Bill, which is to enable the Nottingham Corporation to construct additional works and extend their limits of supply, were resumed to-day.

Mr. Pope, Q.C., Mr. Pembroke Stephens, Q.C., Mr. H. Y. Stanger, Q.C., and Mr. Harold Sands represented the promoters. The following Counsel appeared for parties affected: Mr. Balfour Browne, Q.C., Mr. Lloyd, and Mr. Hugh Hole, for the Newark Corporation; Mr. Erskine Pollock, Q.C., for the Nottinghamshire County Council; Mr. Shiress-Will, Q.C., for the Corporation of Mansfield; Mr. Reader Harris, Q.C., for the Southwell Rural District Council; Mr. Toller, for the Sutton-in-Ashfield Urban District Council; Mr. Pember, Q.C., Mr. Worsley Taylor, Q.C., Mr. Freeman, Q.C., Mr. Statham, and Mr. Rickards, for landowners and riparian proprietors.

The Chairman, at the opening of the proceedings, inquired whether, during the recess, the ideas of the various parties had changed.

Mr. Pope replied that there had been negotiations; but they had not resulted in any alteration of the petition.

Mr. *Barnes*, a surveyor, of Nottingham, was then called. He stated that he was well acquainted with the districts of Oxton, Woodborough, Calverton, and Lambley; and having heard the evidence of Mr. Collier [see *ante*, p. 995], he agreed that the water supply to those districts was bad and had caused sickness. In 1882, witness was instructed by the late Mr. Tarbotton to take the levels of the water at Salterford dam. He took them again in February, 1896; and there was a reduction of 6 inches. In 1887, the water, however, had regained its old level; and he attributed the lowering of the levels in 1896 to the fact that the previous winter had been a very dry one. In his opinion, the sinking of wells at Woodborough and Oxton would not affect the surface waters of the district. Questioned as to statements made with regard to the periodical disappearance of water, witness quoted from an article written by the Rector of Blidworth. Springs to the west of Salterford dam were dry in 1896, but were running now. He had made a careful examination of the villages and property in the neighbourhood of the proposed Boughton well; and he found that the water supply was bad, and that there had been sickness. The water he referred to was surface water; and the statement was an argument in favour of a deep well.

Professor *Hull*, F.R.S., F.G.S., said he had been connected with water questions in the Nottingham district since 1869, when the scheme for taking water from the Dover Beck was put forward by the Nottingham Water Company, and when he appeared for the Corporation to advocate the sinking of wells in the new red sandstone. When it became obvious that the existing supplies to Nottingham must be supplemented, he was again consulted. He made a careful investigation and a report to the Corporation in 1894. He made this report with a view to showing how much water the Corporation could come to. In selecting the sites at Oxton and Woodborough, witness and Mr. Gaskin had regard to the fact that the water flowed in a south-easterly direction. They also had regard to a natural desire not to injure any other well; and he did not think that any appreciable injury would be done to any of the existing wells. At the present time, Newark had only gone down one-third of the depth of the water-bearing strata; and they might increase the present yield of 700,000 gallons by two-thirds. He understood that there had been no deleterious consequences to the Hucknall well. Assuming that Parliament granted the powers now asked for, he was of opinion that there would be still sufficient water to supply all the other districts. On this calculation, after giving to Nottingham the water wanted, and making every other allowance, there would still be a surplus in the district. Witness considered the fall in the source of the Dover Beck to be due to diminished rainfall. In that district, there was considerable variation in the rainfall; and during the past ten years, it had each year been 4·33 inches below the average. There were recurrences of wet and dry seasons. The statement that the Dover Beck was dependent for its supply upon the red sandstone was very far from being correct, as a great deal of its water came from surface streams. It would be totally incorrect to assume that, if the whole of the spring waters were pumped away, the Dover Beck would run dry, for 9 million gallons of the 13½ millions which daily flowed past Gonalstone, according to his estimate came from surface drainage. Witness went on to say that he had had a good deal to do with the water supply of Liverpool at the time when the water for that town was drawn from wells in the new red sandstone. Professor Boyd Dawkins had said he knew of an instance where a well was affected by pumping at another well 3½ miles away; but in that case witness contended that this was owing to exceptional circumstances, there being a fault in the formation which had the effect of conducting the water from one well to the other. At St. Helens, wells had been sunk within 1½ miles of each other, and they had all given good supplies. In his opinion, two miles was a safe distance.

In cross-examination, witness said that since his report to the Corporation was made, he had more carefully studied the meteorological conditions of the district. He admitted that, whether the Corporation took the surface or the underground water, the effect would be the same—the same water being taken. When he spoke of an average of 9 million gallons coming down the Dover Beck, he allowed 4 million gallons from the stream; but on the Keuper formation there was an average of 9 million gallons, taking this figure as being two-thirds of the rainfall.

In answer to Mr. Shiress-Will, witness said he was responsible for recommending the two wells at Oxton and Woodborough; and he stated in his report that Nottingham had manifestly the first claim to them. This was a powerful reason with him for recommending the sites. The fact that he did not anticipate any difficulty in Nottingham in obtaining them was an important factor in leading him to suggest them. Witness was closely examined on his report of 1894, and asked whether anything had happened since then to vary his calculations. He replied that the increase in the population affected them.

In reply to questions by various Counsel, witness said he would not recommend Nottingham to sink more than one well at Boughton, lest they should interfere with some other authority—Mansfield, for instance. He thought wells might be within 2 and 2½ miles of each other with comparative safety; but for perfect security, he should say the distance should be a dozen miles. The area of a two-mile radius was about 12 square miles. Though the Corporation had only the right to sink one well, they could drive what headings they pleased within that area, which extended beyond the pebble beds and on to the Keuper. Asked if the construction of headings would not serve better than two wells, witness said he would rather not answer the question. He would not admit that it was possible to put in headings sufficient to tap all the water. There was not a single well in the new red sandstone capable of yielding 4 million gallons of water per day; and the Corporation required 6 million gallons. At present there was a surplus of 7 million gallons, of which 6 millions flowed down the Diver Beck. This quantity would be available for pumping; but it would not be pumped. The Woodborough pumping-station would not be sufficient for Nottingham for a very long time; but it would be a step towards it. It was his opinion at the inquiry last year that the Woodborough station would suffice for a long time; but he would protect the Corporation by getting the other well at Oxton. When he gave that evidence, he had not Boughton in his mind. He did not think pumping at Oxton would affect Farnsfield.

Wednesday, April 28.

Professor *Hull* was further cross-examined this morning; and in the course of his replies, he stated that if there were no other sites near at hand, the Boughton one would be preferable so far as the storage of water was concerned. Assuming that Nottingham could obtain all the water they wanted at Boughton, he did not agree that it would be better to keep to Boughton alone, for both Oxton and Woodborough were close at hand, and there was an abundant supply. He admitted that his great objection to being confined to Boughton was in regard to the expense.

Re-examined by Mr. Pope: His report to the Nottingham Corporation in 1894 was a minimum one; and he did not pay particular attention to the maximum quantity of water which might be obtained. One inch of rain on a square mile was taken at 40,000 gallons; and if there were 17 inches of rainfall, this meant 680,000 gallons per square mile. These figures multiplied by 27, the number of square miles, represented 18,360,000 gallons per day instead of 16,200,000 gallons, as he had stated in his report.

Mr. Pope: You have been asked to assume as a possibility that you could get from Boughton as much water as Nottingham needs. Is it, in your judgment, possible with the one well, and with the restrictions which the agreement with the landowners has placed upon us, to obtain from Boughton more than 3 million gallons?

Witness: That is the limit. Therefore any excess required at Nottingham over the 3 million gallons must be supplied either by the sinking of fresh wells at Boughton or somewhere else; and I recommend Oxton and Woodborough. The pumping at Oxton could not affect the Sutton-in-Ashfield well, for the reason that the Oxton well could not pump water until Sutton had had its chance at the whole quantity available,

Equally so the Woodborough well would not affect the Hucknall well. The only possible injury to the Dover Beck area would be to the surface springs. In my opinion, there would be none to the surface streams.

Mr. *C. E. De Rance*, F.G.S., said he had been for 22 years Secretary of the Underground Waters Committee of the British Association; and in his judgment the proposed sites had been well chosen by the Nottingham Corporation, especially the one at Woodborough. They would do no injury to other people if they pumped 2 million gallons of water a day from each well. It would be practically impossible for the Oxton people to pull back the water from the natural trend. The suggestion of the Newark Corporation that they should lock up the whole of the water in the pebble bed area, in order to protect a million gallons, was an intolerable proposal, and one which he had never heard made in that House, where he had been a witness during the last 25 years. He felt confident that the pumping of water had not injured the Dover Beck. He thought it was only fair and equitable that the quantity drawn should be limited to 2 million gallons a day. If it were true that pumping had depleted the water in the basin of the Dover Beck, the water would of necessity have fallen back. He was of the opinion that the existing pumping-station had as much to do with the depletion of the Dover Beck as the Thames water-works. If it could be proved that the Nottingham Corporation diminished the rights of the riparian owners, he quite agreed that they ought to give compensation, though they might not be strictly liable in law. Witness went on to say that, even allowing for all the suggestions made, such as the driving of adits, the most that could be relied upon at Boughton would be 2 million gallons a day. The driving of adits could not increase the quantity of water; they could only make for the constancy of the supply. If the adits were driven deep, they were dangerous; if driven shallow, they would be ineffective by reason of being above the saturation level. He estimated that the proportion of rainfall which passed into the sandstone was 10 inches, which would give 400,000 gallons per square mile per day, or a great deal more than would ever be required by the people of the district. He thought it was a great pity there should be such squabbling for water when there was plenty for everybody.

Mr. SHIRESS-WILL: Do you pledge yourself that if the Oxton well is sunk it will not affect the Mansfield well?

Witness: I have every reason to believe that it is impossible.

By Mr. BALFOUR BROWNE: Outside the space required by the one well, the Nottingham Corporation could sink several others within their protected area, from each one of which 2 million gallons a day could be obtained. Oxton was not in such a good position for a well as Boughton. He was aware that at several wells in the red sandstone much more than 2 million gallons could be taken from each; but his point was that it would not be safe to rely upon one well to give more than this quantity per day.

By Mr. READER HARRIS: There were no water-tight layers in the pebble beds which prevented the water from percolating; and consequently, by means of properly-driven headings, all the available water could be tapped. He still adhered to his contention that the driving of headings did not increase the supply of water. If the Engineers at Nottingham put their headings down for any other than storage purposes, they were wrong. The making of headings was an old-fashioned idea. He did not admit that by making headings a larger area of water would be tapped.

Mr. READER HARRIS: Are you going seriously to tell the Committee that in that two-mile radius at Boughton, if you had adits radiating in different directions right out to the limit, you would not tap a much larger area?

Witness: They would be useful in making a way to the well for the water; but they would not add a single gallon.

The whole area is 12 square miles; and you have given 400,000 gallons as the quantity available per mile—making 4,800,000 gallons altogether. Would you say it would not be safe to get 4 million gallons per day from Boughton?—I would say that the gathering-ground would yield 4 million gallons. Continuing, witness said that there was only one known fault in the pebble beds of Boughton. If a dangerous fissure was met with, the water could be tubbed off by lining the fissure.

Thursday, April 29.

Mr. *De Rance* was further cross-examined this morning. In reply to Mr. Freeman, he said it was distinctly his opinion that, in supplying Nottingham with water, no damage should be done to the riparian owners, and that such owners should be safeguarded. The district of the Dover Beck was an extremely porous one—the most porous he had ever seen except Aldershot. He agreed that the Nottingham Corporation were very wise in securing the Oxton site for the purpose of preventing any other authority coming there and pumping water from the Woodborough well. This was, however, not the only reason why Nottingham went to Oxton. It was because they wanted a permanent supply of 2 million gallons from two wells. Possibly the Papplewick well was now pumping more than this quantity; and in his opinion the Corporation might for a time pump 3 million gallons a day from Woodborough well.

Re-examined by Mr. POPE: He agreed with Mr. Gaskin that the water originally pumped at Papplewick and Bestwood was from the accumulation of water; and this was what was meant when it was said that the immediate result of pumping a well did not coincide with the amount obtained permanently. When the storage water had been pumped, they at once sank down to the natural saturation level. If the Dover Beck was not materially interfered with, the millowners could have nothing to say; and once more he said that if they were affected, they ought to receive compensation. From his observations, he was convinced that there never was a large stream in the course of the Dover Beck.

Mr. *E. Easton* said it was the intention of the Nottingham Corporation to obtain, in round figures, 6 million gallons of water a day; and he thought this would by no means exhaust the underground water. In his opinion, there were perhaps 30 or 40 million gallons to be pumped from the district every day. He did not think the pumping of 6 million gallons would be injurious to the Dover Beck; or that any quantity that could be pumped at Woodborough would affect the stream. In 1869, 6 million gallons daily flow was the minimum; but he was quite certain that the water in the channel in the summer of the previous year was very much less. His recollection of the Dover Beck was very clear, and, in his opinion, the stream had not diminished at all. It was absolutely necessary, if Nottingham was to be made perfectly safe, that there should be an additional supply of water.

In answer to Mr. SHIRESS-WILL, witness said the area he had in his mind when he mentioned the possibility of obtaining 30 million gallons a day extended from Basford to six miles beyond Mansfield. He took the quantity of water percolating at 12 inches. But he did not dissent from the suggestion that there would be 15 inches in a wet season; and therefore his estimate of 30 millions would be proportionately increased. So far as the underground water was concerned, Oxton was on a higher level than Woodborough; and therefore it was a place from which water flowed away. He estimated that the scheme would supply about 22 or 23 gallons per head per day; and he was not aware that it was intended to supply 33 gallons. Looking forward 20 or 25 years, he could not say what would be an ample supply per head of the population; but 25 gallons was a fair and adequate supply now.

By Mr. PEMBER: The Dover Beck was a stream not liable to excessive floods; but at Epperstone it frequently contained three and four times as much water as it ordinarily had. He had not taken any gaugings of the stream either in 1895 or 1896; but he was not aware that the minimum flow in the latter year was rather more than 3 million gallons, against upwards of 6 millions in 1868.

Re-examined by Mr. POPE, witness said that with regard to the quantity of water estimated per head of the population, his figure of 25 gallons was where there was a reserve supply. Where there was no reservoir, they had no water to fall back upon. Under a pumping scheme, they lived, so to speak, from hand to mouth. In his judgment, pumping at Oxton and Woodborough could not affect the Mansfield well, for the reason that it was in the upper part of the great water basin in question. The Papplewick well was at a lower level than the one at Mansfield, and the last-named well got the first pull at the water; and pumping at Papplewick could not interfere with the supply at Mansfield, inasmuch as Mansfield took their water first. The Oxton well was nearly 100 feet below the Mansfield well; and if Mansfield could pump all the water passing their well, Oxton would get none. The Oxton water was about level with Papplewick; and, if dealing with a comparison, Woodborough was a better site. He agreed that the possible limit at Boughton would be more than 2 million gallons.

Friday, April 30.

Mr. *G. H. Hill*, M.Inst.C.E., examined by Mr. PEMBROKE STEPHENS, said as regarded Nottingham itself and its requirements, there was in his opinion an absolute necessity for a further supply of water. With continuous pumping, the Corporation would, in the event of a breakdown, have to put the inhabitants on short supply. Three additional wells were required; and one should be obtained at once. He thought the quantity of water should be at least 25 gallons per head per day; and he estimated there would be an average daily demand of 8¾ million gallons. He agreed with the evidence given that 2 million gallons was a safe quantity to pump from each well. He thought this could be drawn without detriment to the neighbouring wells; but it might possibly have a slight effect upon the Dover Beck. To the extent that one well rested, time would be given to the underground water to recover. For the purposes of rest in that locality, it would be better to have six wells, of which one would be resting, instead of having five wells and all of them continuously working. So far as the Sutton-in-Ashfield, Mansfield, and Newark wells were concerned, it was impossible to say that there might not be some consequences; but he did not think this could be serious. With regard to the alleged sympathetic relations of the surrounding wells, it all depended upon the quantity of water; and in his view there was a considerable surplus. For instance, Newark, though it took the extraordinary quantity of 40 gallons per head per day, could not possibly exhaust its supply. He had never heard of such a proposition as that made by Newark. There was absolutely no need for it; and it was altogether without precedent that 50 square miles of water-bearing land should be locked up for one little town. If Newark paid for the land they proposed to lock up at the same rate that Nottingham proposed doing for its protective zone, it would represent a perfectly crushing sum. With reference to the suggestion that Nottingham should go to Boughton for all its water, in his opinion there would be a considerable amplification of the opposition which was at first offered to the proposal to sink one well only at Boughton. The policy of putting all their eggs in one basket at Boughton did not commend itself to him; and he thought the Corporation would not be safe unless they had two wells for a further immediate supply, and a third to give the others a rest.

In cross-examination by Mr. SHIRESS-WILL, witness said his estimate of 8¾ million gallons was based on a population of 350,000 fifteen years hence. This was nearly 3 million gallons in excess of the present quantity of water which Nottingham pumped. He combated the view that one additional well would be sufficient, as not more than 2 million gallons could be relied upon. The Oxton well would not exhaust the supply at Mansfield; but it might affect it.

Re-examined by Mr. PEMBROKE STEPHENS: A corporation, even of a town of the size of Nottingham, ought to have some regard to the cost of a scheme. The Woodborough scheme would be the cheapest; then the Oxton well; and next the Boughton well. He did not think the Corporation would be justified in obtaining all their water from the most expensive source. At present the town had only 1½ days' storage; and the Bill proposed to double it—a wise and proper provision. There was not only plenty of water in the pebble-beds area in question for everybody, but a big surplus.

Sir *F. Bramwell*, F.R.S., was the next witness. He stated that he had knowledge of Nottingham, which was a town where great care had been taken to keep down waste of water. Whereas the consumption there per head was 21 gallons per day, in London it was for domestic purposes 30½ gallons. Nottingham at the present time was in real peril; and two wells ought to be commenced immediately. In his opinion, they would not be safe with one additional well; and he believed that the wells at Woodborough and Oxton should be begun at once. They would, he thought, be quite innocent of any ill consequences to any other well. The mere provision of one well would not put Nottingham in a safe position, especially having regard to the growing needs of the population. The great dispute was not so much as to the needs of Nottingham, but the consequences of sinking the wells; but he did not think there was

any real danger. Taking the figures with regard to 10 inches of rainfall supplying 400,000 gallons per square mile, each five square miles in the area would give a well a supply of 2 million gallons. Where wells were in competition, the level of one might be reduced; but this did not mean that the water would be taken away—only that the well would have to be deepened. [Witness produced a model exemplifying what he had just stated, and showing how a cone of depression created by one well could not prevent another well from getting water.] Continuing, witness said that in driving over the Dover Beck district they did not find any surface ditches; and this was what was found in the chalk area. It was a highly porous district. As a rule, an engineer took care to "tub out" the surface water, so as to draw solely from the underground water. At Oxton and Woodborough, if they put in an impermeable water-tight lining, they would only pump from underground sources. He was convinced there was no connection between the water in the borehole at Woodborough and that in the Dover Beck. In conclusion, witness said it would be greatly to be deplored if Nottingham had to go back with parliamentary sanction for only one of the proposed wells, for all three were absolutely needed for the safety of the town. What he wanted to emphasize was that there was water enough for all, in fair competition. It would be perfectly possible for the Committee to say that the Corporation should not take from their proposed wells at Oxton and Woodborough more water in two or three months than would work out to an average of 2 million gallons a day; thus safeguarding the interests of other local authorities. This would be a condition of things which could not have any injurious effects. He had never in all his experience heard of such a Bill as that brought forward by Newark. The notion that they should abrogate to themselves such an area as they proposed was not to be for a moment tolerated.

Cross-examined by Mr. Shiress-Will: His suggestion was that Nottingham should start with two wells immediately; and he was rather surprised that the increase of 4 million gallons a day would furnish an increase of 14 gallons per head per day to the present population. This would immediately give a supply of 35 gallons per head per day. But he objected to the suggestion that two wells were sufficient, for the reason that Nottingham would in a few years be put to the expense of coming to Parliament again. Examined with regard to the yield of a well, witness said he had no doubt a well might at the outset furnish as much as 3 million gallons per day; but he would not venture to express an opinion as to the period during which this would continue. If the Mansfield well was one of large supply, he quite agreed that a cone of depression caused by another well would affect it; but otherwise it was only a matter of deepening the well. The question of the lowering of the water had nothing to do with the quantity. Assuming the Mansfield well was affected by the Oxton well, it would not be necessary for Mansfield to sink their well deeper if the Nottingham Corporation deepened the Oxton well. He did not suggest any compensation in case of the wells of local authorities being affected. What he said was that Nottingham was entitled to the water; and so long as they took no more than their fair quantity, there was no reason why they should not have it. No matter what abnormal conditions obtained, he was confident that everybody would get sufficient water from the area in question.

By Mr. Erskine Pollock: It was not absolutely necessary to have a rest well, but eminently desirable. His view was that in fifteen years' time the whole of the three proposed wells would be working usefully; and he thought it was extremely likely that the Boughton well would be wanted in that time as a working well. Asked as to whether the underground reservoir had any outlet in the direction of the sea, witness replied that it was obvious that, if there were no outlet, and the rain fell continuously into the porous formation of the area, the time would come when it would rise to the surface in the form of a lake or large stream. There was no lake and no large stream in the district in question; and therefore the water must flow away underground.

The Committee then adjourned till Tuesday, May 4.

The Charge for Gas and Coke in Liverpool.—At the meeting of the Liverpool City Council last Wednesday, Captain Denton proposed the following motion, of which he had given notice: "That the Lighting Committee be instructed to enter into negotiation with the Liverpool United Gaslight Company, with the object of obtaining from the Company a reduction in the price of gas to consumers in the city who have adopted the automatic 'penny-in-the-slot' system, and who now pay in advance 7d. per 1000 cubic feet more than the ordinary quarterly consumer pays after supply; and, further, to try and obtain for the citizens greater facilities for purchasing coke at the same price as the Company receive by sending that fuel out of Liverpool." Mr. Ellis seconded the motion, which was opposed by Mr. Oulton and Mr. Dart, on the ground that it was unnecessary. Upon a vote being taken, it was ascertained that there was not a quorum present; and the Council were therefore counted out.

Lincoln Corporation Gas Supply.—At the meeting of the Lincoln City Council last Tuesday, the Gas Committee recommended the transfer of £1500 from the revenue account to the credit of the general district rate. Alderman Page said the gas undertaking had continued to progress during the past year. The gross profits, which were £10,897 this time last year, had increased by £862; and the net profit was £3485, as compared with £2637 in 1896, notwithstanding that they had given the consumers the benefit of £1000 in abolishing meter-rents and reducing the price of gas. The balance to the credit of the profit and loss account was £6720; and they proposed to carry £5220 to the profit and loss account, as against £3235 previously carried forward. During the eleven years they had owned the gas undertaking, they had not made any additions to capital outlay. The time had arrived when the expenditure of a considerable sum was inevitable, as during the winter months the strain on their manufacturing capacity was very great. They were able to produce at all their works a total output of 1,300,000 cubic feet of gas; and when he told them that during the winter the total consumption was 1,325,000 cubic feet, they would understand the Committee were glad when the dull, dark days were over. They hoped by temporary arrangements to steer satisfactorily through the ensuing winter; but when this period was passed, they would be face to face with a large expenditure. The recommendation was agreed to.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Monday, May 3.

(*Before Baron* Pollock *and a Special Jury.*)

Fox v. Jerome—The Water-Gas Libel.

The proceedings in this case were resumed to-day.

After the evidence, taken on commission for the purposes of the Notts and Derby Water-Gas Company's action, of Herr Kuppelweiser had been read to the Jury,

Mr. *D. Graham* of Skelmorlie Castle, Bridge of Allan, gave evidence as to his retirement from the Board of the North British Water-Gas Syndicate. He stated that he was a member of the firm of Messrs. William Graham and Co., East India Merchants, of Glasgow and other places, and attended to give evidence on subpœna. He heard in April, 1889, that the British Water-Gas Syndicate came into existence; and he afterwards had his attention called to the proposal to form a subsidiary Company, called the Scottish Water-Gas Syndicate. But, this title having been registered, the Company was called the North British Syndicate. Mr. Robert Scott first mentioned that Company to him on the 30th of April, 1889; and in consequence of what he said, witness went to the Central Hotel, Glasgow, to meet several gentlemen interested in the Company, and to see some experiments. This was the first occasion on which he met Mr. Fox.

Sir F. Lockwood: Were you asked on that occasion if you would join the Board?

Witness: Yes; Mr. Robert Scott asked me. I desired time to consider; and later in the day I wrote a letter declining. I took this letter to the hotel, and saw Fox and Cottam. There was a good deal of conversation on the subject of water gas; these gentlemen being sanguine as to its prospects.

Did you, in consequence, reconsider your decision?—Yes; I changed my mind, and agreed to join.

Did you on that day get a proof of the prospectus?—Yes; I think Mr. Cottam gave it to me. I read it through on the evening of the 30th of April; and, in consequence of what I saw in the prospectus, I called on Fox the next morning, and expressed generally my doubts as to the advisability of joining the Board, as I had not sufficient knowledge of the subject.

Did you afterwards write a letter to Fox?—Yes; and I expressed the doubts I had mentioned at the interview. In receiving Fox's reply, I at once called on him. I directed attention to the amount to be paid to the parent Syndicate, which in the prospectus was stated to be £200,000 in cash, £50,000 in fully-paid ordinary shares, and £1000 in founders' shares. I objected to this because it was not what I had been told before. It was to have been half cash and half shares. I pointed it out to Fox; and he said it was an error, and would be altered. Subject to this alteration, I consented to go on.

In further examination, witness said: I received on the 2nd of May a letter from Fox in which I was told that the prospectus had gone to press, and could not be altered; and in a telegram on the following day, Fox informed me: "Find it was too late to get price altered in prospectus, but British Water-Gas Board now sitting agree to a revision." I replied: "Cannot see how prospectus could go out without alteration—too serious an error;" and I asked, for domestic reasons, that I should be allowed to take the opportunity of withdrawing from the Board. The reply was: "Prospectus has already been issued. If you were to withdraw now, it would be absolutely fatal to the whole thing." I answered that I was "greatly annoyed. Mischief seems done. Cannot consent. Reserve my freedom of action after consulting my Solicitors." On the morning of the 4th of May, I consulted my Solicitors; and I telegraphed to Fox: "Am advised that I am legally entitled to withdraw from Board, and have absolutely decided to do so. Desire to do it in the best possible way for the Company; and if you will telegraph that you will insert in newspapers in which the prospectus appeared that since the prospectus was written Donald Graham prefers not to act owing to pressure of business, will not send out statement." The reply of Fox was that I had never properly withdrawn from the Company, and there must be nothing done to injure the Company or their interests. Cottam also wired that he would arrange the publication of my resignation on the following Monday. On the 6th of May, I telegraphed: "I distinctly say that I resigned the moment I learned that you were not carrying out the assurance given me to alter the figures in the prospectus."

Sir F. Lockwood: When you found out that this assurance was not carried out, you resigned?

Witness: Yes; on the 3rd of May. On the 6th of May, I received a telegram from Cottam asking me to leave the matter till the following Thursday; while Fox wired making a similar request. I replied that I adhered absolutely to the position I had taken up. On the 7th of May my Solicitors, on my behalf, disclaimed any responsibility for the unwarrantable inclusion of my name in the prospectus, and said they would lay all the consequences on Fox and Cottam and the other officials. I do not think anybody answered that letter.

When first was any memorandum published which stated that you intended to retire from the Board?—It was arranged between my Solicitors and the Solicitors of the North British Company. There was a notice sent out to the shareholders with the allotment letter.

Cross-examined by Mr. Asquith: I was an old friend of both Robert and John Scott. They were, and are still, persons of good commercial position in Glasgow. I had great confidence in their judgment in business matters; and I have still. At the time the matter was first introduced to me, the names of Mr. Reid Stewart, a wealthy Glasgow gentleman, Mr. Cayzer, a shipowner, and Mr. James Reid, the Chairman of Nobel's Explosives Company, were on the prospectus; and they were gentlemen well known and of high commercial position in Glasgow. I was impressed with what I saw at the experiments; and in the afternoon of that day I agreed to become a Director. The doubts I felt did not arise from want of *bona fides* in the gentlemen interested in the Company.

Mr. Asquith: An applicant for shares in the Company would consider the fact that £200,000 was to be paid in cash made the thing look less attractive than if only £125,000 was to be paid?

Witness: Yes; I think he would. Fox said that statement was an error; and he wrote out a telegram to put it right.

On the evening of the 2nd of May, you did not consider that you had retired from the directorate?—No, because the alteration was to be made; and if it had been made, I should have felt bound by my promise to be a Director. On the 3rd of May, the prospectus was advertised in the daily papers. Domestic reasons operated very much in my mind in retiring.

Do you say that business engagements were a ground for your retirement?—Yes; one of the grounds.

Re-examined by Sir F. Lockwood: My substantial objection was that I had not sufficient knowledge of the subject, and that the amount to be paid in cash was larger in the prospectus than I had been led to believe. I never sanctioned my name appearing on the prospectus in which the sum of £200,000 was mentioned.

Mr. *J. Petty*, who up to 1896 was the costs clerk at the Leeds Forge, examined by Mr. Bigham, said in September, 1895, when the action of *Christie v. Fox* was pending, Mr. Fox asked him to make up a statement in reference to a paragraph in the Leeds Forge prospectus that a saving of £10,000 a year had been effected by the adoption of water gas; and, in order that he might do so, he had given to him three questions taken out of a report made by Mr. Wildey, the Engineer. The first question asked how 100 per cent. more material was produced in a given time by the use of water gas; but witness's answer was: "Cannot trace," because the figures could not be found. The second statement was: "Reduction of cost of gas equal to 62 per cent.;" and he told Fox that he thought Mr. Wildey arrived at his figure by taking the cost of coal gas got from the Leeds Corporation's half-yearly account to June, 1888, which gave 11,979,900 cubic feet of gas at 1s. 10d. per 1000 cubic feet, £1098.

Mr. Bigham: Did you attempt in any way to verify the suggestion that there was a reduction in the cost of gas of 62 per cent.?

Witness: That was all I could gather.

Do you find any justification at all for the suggestion that by using water gas there was a reduction of 62 per cent. in the cost of gas?—I cannot trace it.

Examination continued: The last question related to a statement that the cost and wages combined saved 58 per cent.; and my answer was that Mr. Wildey took the £1098, and subtracted the £477 charged for wages on gas account to Dec. 31, 1895; and this left £621. The £477 was gas-making wages, and did not include the cost of fuel. The amount paid for coal gas was something like double that paid for wages in making water gas. Mr. Fox sent for me to go to his private room at the Leeds Forge, where he had some loose sheets containing results of experimental steel smelting. I was asked to make out the saving of £10,000 a year; and I took the sheets away, but could make nothing of them.

Mr. Bigham: Were any figures ever produced to you afterwards which would enable you to make up the sum of £10,000?

Witness: Mr. Simpson, who was head clerk to Mr. Gordon, made some abstracts; but there were no figures in existence which would show a saving of £10,000. There were no meters to measure the water gas at the works; but the gas was measured by the rise and fall of the holder.

Cross-examined by Mr. Boyd: Mr. Gordon, Mr. Simpson, and I were a few months altogether at the books. Those gentlemen made extracts, and gave some of them to me to verify; and I made some alterations. It was not my business to enter up the sheets showing the gas made at the Leeds Forge; but I recognize some sheets which give a report made every ten minutes by the workmen superintending the manufacture of water gas. The figures arrived at by Mr. Gordon in reference to the saving effected by the introduction of water gas for steel smelting were accurate; and they show that with water gas 1 ton 8 cwt. 2 qrs. could be produced in one hour, as against 1 ton 1 cwt. by the old process. In signing the statement that a saving of £12,500 was effected, I did not examine the items. Mr. Wildey was at the works the whole time the saving of £10,000 was supposed to be made.

In re-examination, witness said he was at the Leeds Forge in 1889; but there was no calculation made to verify the statement that £10,000 was saved by the use of water gas, so far as he was aware. The first attempt to justify the statement was in 1895, for the Christie action.

Tuesday, May 4.

Mr. *T. W. Simpson*, partner in the firm of Messrs. Lund and Co., glass manufacturers, of Castleford, Yorkshire, examined by Mr. Danckwerts, stated that in the autumn of 1890 he was acquainted with Mr. Mitchell, the Chairman of the Yorkshire Water-Gas Company, who was now dead. His firm were approached with regard to the erection of a water-gas plant. The plant was to work in connection with ordinary producer gas, to melt the material required to make glass bottles. They were supplied with an estimate for the work, in case the plant should prove successful, and they should wish to purchase it. The contract was that the Yorkshire Water-Gas Company undertook to put down the plant on the terms that they guaranteed a saving of time and fuel over the system then in use at witness's works; but they were unable to state the exact amount of saving. It was to be sufficient in extent to satisfy the firm of its commercial value; and if the plant did not turn out a success, the Water-Gas Company were to move it free of expense. The plant was erected under the supervision of an Engineer (Mr. Craven) of the Yorkshire Company, and consisted of a water-gas generator, scrubber, gasholder, blower, and Wilson's producer with the necessary valves. The steam power was supplied from the boilers of the firm.

Mr. Danckwerts: What was the result of the experiments?

Witness: The result was that water gas made no difference at all in the time of melting. Commercially it was not a success.

Were the experiments finally abandoned?—Yes; about the end of March, 1891. We saw that we could do no good; and Mr. Scudder advised us to discontinue the experiments. We called on the Yorkshire Company to remove the plant; but it remained on our premises until June, 1894. The scrubber and generator were then taken by the Company to a boiler maker's in Castleford, where they are still.

Did you buy the Wilson producer?—Yes; we bought it with a lot of other things for £20. The gasholder was sold at old-iron price to Messrs. Clayton and Co., of Leeds. The fuel and labour for the water-gas experiments were found by the Water-Gas Company.

Cross-examined by Mr. Boyd: Mr. Mitchell was a large proprietor of collieries, and was well known and respected in Yorkshire.

Mr. Boyd: Was this the first time that water gas had been applied to the melting of glass?

Witness: I believe it was. They do not make glass at the Leeds Forge.

Did your engineers put up the glass-blowing furnace?—Yes; our labourers put up the tank. The water gas had to mix with coal gas; and both the coal gas and the water gas were under the direction of Mr. Craven.

I suggest to you that the reason water gas failed was that the glass melting furnace was about four times too large to be used in connection with the water-gas plant?—It was not so.

Did you specify for the water-gas plant?—We merely gave facilities to these people of proving that water gas could be used for melting glass.

It is said the generator put in was much too small?—Well, it was so small that it produced no effect. The generator was estimated to cost £990. We could obtain the same results for somewhere about £120 with producer coal gas.

The gas produced apparently was not sufficient for this purpose?—It did not answer the purpose.

I want to ascertain whether it was a specific case of the generator being too small, or whether it was some inherent defect in water gas which caused the failure?—I say that the water gas produced in this plant, either because there was not enough of it, or because it would not produce enough heat, failed to effect any saving of time or fuel.

Did you examine the experiments sufficiently to tell?—I was there during the whole time, and took a great interest in them.

You do not know with regard to the relative intensity of the heat as between water gas and producer gas?—I know from practical experience that in our furnaces the water gas does not give off the same amount of heat. It does not develop the same heat as producer gas.

We have been told that the flame of water gas gives a greater heat?—I believe the flame is hotter than the flame of coal gas. It is the intensity of temperature in the furnace that we want, not the intensity of flame. We want a big heat over the large furnaces. The furnace experimented on was the smallest we use.

Do you know at all what the power of the generator was?—I do not.

Mr. *W. Paris*, assistant commercial manager of the Glasgow Iron and Steel Company, Ltd., examined by Mr. Danckwerts, stated that in 1891 his Company entered into a contract with the North British Water-Gas Syndicate, under which the latter were allowed to erect a water-gas plant for the purposes of iron puddling, with a view of the Iron Company adopting it if successful.

Mr. Danckwerts: Were the experiments successful?

Witness: Not so far as we were concerned. The puddling was commenced on Feb. 9, 1892, with producer gas. Up to July 9, 395 tons of iron was produced, with 420 tons of coal. From Aug. 6 to Oct. 22, producer gas and water gas were used; and though the production of iron was up to what could be expected, there was no saving of fuel.

Was every facility afforded for the experiments?—Yes; and Fox gave the furnacemen a premium. It was arranged that Mr. Scudder should specially weigh the fuel used, with the result that he took more fuel in his furnace than ordinarily.

How did the use of water gas compare with the ordinary process?—It did not forward the thing at all; and the experiments were a failure commercially. The use of water gas was abandoned, and has not been resumed.

Cross-examined by Mr. Asquith: It is only in reference to puddling that I have had practical experience of water gas. I was in the employ of Mr. Reid Stewart for 37 years; and he was a man of high reputation. Before water gas, we had not used gaseous fuel for puddling.

Mr. Asquith: Is it not a fact that the periods of heating which took nine hours with coal, only took seven with water gas?

Witness: We did not compare the time.

Did you become aware that it is essential for the proper use of water gas that there should be continuous working?—I believe that may be an advantage. The working could not have been more continuous than it was. It was after the second experiment that the use of water gas was abandoned.

Mr. *A. Moss*, a partner in the firm of Moss Bros., of Eastwood, fustian manufacturers, examined by Mr. Danckwerts, said in the middle of 1889 the Yorkshire Water-Gas Company erected a plant for singeing at Eastwood; the price agreed upon being £773. There were a number of failures before the plant was got to work—including two explosions with the steam-blower. In 1891, witness's firm called on the Syndicate to remove the plant. But arrangements were made for the experiments to be continued for three months; and a fresh valve was put in. Ultimately £350 was paid for the plant, and £50 for the licence.

Mr. Danckwerts: At what price per 1000 cubic feet did the Syndicate tell you the gas could be produced?

Witness: Not more than 6d. per 1000 cubic feet; but it would be less if a large quantity was made. The gas at present costs 10d. per 1000 cubic feet. We are still using water gas; but it is made under different conditions. We have a generator of our own construction; but we do not use the water-cooled ring or the patent valve of the Water-Gas Syndicate. Our steam-jet passes into the generator at the bottom, whereas that of the Syndicate goes in at the top. We think we get a drier and cleaner gas; but we throw the producer gas away.

Cross-examined by Mr. Asquith: We changed our generator eighteen months ago. The capacity of the plant at our works was 2000 cubic feet per hour. Coal gas at Eastwood costs 3s. 1d. per 1000 cubic feet. In the first instance, there was a defect in the valve erected. In October, 1891, we gave a certificate to the Yorkshire Company that the water-gas plant worked well. We continue to use water gas for singeing; but I do not think we should adopt it now. All our neighbours in the same trade use coal gas. Water gas is a flame without carbon; and it makes no carbon deposit. When coal gas is used, it costs more to bleach the material, on account of the deposit.

Re-examined: The cost of 10d. per 1000 cubic feet for water gas does not include the cost of distributing.

Mr. *J. M. Greg*, assistant manager of the Lancaster Waggon Works, gave a detailed account of the plant erected by the Yorkshire Company at his works in 1890. The plant was for wheel welding; and certain results were guaranteed—payment being contingent on these results being obtained. The guaranteed results were not secured; and the price agreed upon was

not paid. The crude gas was used under the boiler. For welding wheels, water gas was a good thing, if it was kept in order. If the crude gas was utilized, the thing was about square with the old system.

Cross-examined by Mr. Asquith: Water gas made a good weld; and they were still using it. He paid a visit to Germany in 1893, in company with Mr. Ritchie, a chemist connected with the Bairdmore Steel Works, Glasgow, with the object of seeing water gas in operation. They went to Essen and to Pintsch's works at Fürstenwalde. At those places, water gas was used for brazing and welding. They talked the matter over together; and the question turned upon the use that could be made of the crude gas. Practical results showed him that water gas was of importance for welding; and for purposes of economy, he wanted to use the crude gas.

Mr. *W. Vint*, Manager of Messrs. Harris and Vint, deposed to experiments in water gas for lighting purposes having been made at his works. The gas was used in connection with the Fahnehjelm comb; but the result was unsatisfactory for the lighting of the worsted factory for which it was used. The light was not sufficient; and there was danger of fire. The comb might answer where there was no vibration; but it would not do for a factory. When the comb failed, the Company offered to supply the carburetted process; but they did not do so. They wished the Company to take the plant away. It, however, remained for two years at their works, and was then removed to the mill of Messrs. Clough Bros., where it was used for singeing yarn.

Cross-examined by Mr. Asquith: He had heard that Cloughs were satisfied with the process. He found the result satisfactory for singeing; but there was no saving in cost. The reason his firm did not keep it for singeing, was that they did not care to have two kinds of gas on the premises. For spinning grey worsteds, they required a good light; and they used burners consuming 8 or 9 cubic feet of gas per hour.

Mr. *J. W. M'Raith*, J.P., who acted as Solicitor to the Notts and Derby Water-Gas Company, stated, in answer to Mr. Danckwerts, that in May, 1889, he attended a meeting of the Directors at the Holborn Viaduct Hotel. Cottam and Fox were present; and the latter asked the Directors to make a payment on account of £30,000 in respect to the £101,000 consideration money. The Directors objected, on the ground that there was no justification for payment in advance. Cottam was sitting next to Mr. Cox, a Director, who said he thought the Directors should know what Cottam had told him. Cottam said: "For God's sake let's have the £30,000, as we have £170,000 to pay in differences over the water-gas settlement." The Notts and Derby Directors replied that that did not influence them in their judgment; and though Fox pressed strongly, they declined to make any payment.

Mr. Danckwerts: Did you on several occasions meet Cottam and Fox with the Directors of your Company?

Witness: I did; and complaints were made by Cottam that the Notts Directors did not support the share market. The answer was that that was no business of the Directors. They had to make the thing a commercial undertaking, and had nothing to do with shares. In October, 1889, the Notts and Derby Company refused to carry out the contracts with the British Syndicate, on the ground of misstatements in the prospectus. The parent Company then issued a writ; and evidence was taken abroad. Ultimately a compromise was effected, by which the Notts and Derby Company paid £15,000, instead of £101,000; each party paying their own costs.

Cross-examined by Mr. Boyd: He understood that Cottam wanted £170,000 to pay differences. He did not know who he meant by "we have to pay." He admitted having told the shareholders at the statutory meeting of the Notts and Derby Company that the vendors followed the usual course, and did not guarantee the validity of the patents. In the case put before Counsel, fraud in the prospectus was not alleged, because they did not have the evidence of fraud until afterwards. When the settlement of the action was effected, the rights were returned to the parent Company.

Mr. *T. Leah*, a hammerman of Chapel Allerton, Leeds, gave evidence to the effect that he had known Samson Fox all his working life. After the Water-Gas Syndicate had been brought out in 1889, he had conversations with Fox. He had applied for 100 shares, and was allotted five in the Syndicate; and Fox told him to go on the market, and buy others at a premium. He bought 105 shares in the Yorkshire, 100 in the Notts and Derby, and 75 in the North British Company—nearly all at a premium; and some time afterwards he bought 490 North British shares at rubbish price. In all he invested between £1000 and £1500 on the faith of the statements in the prospectus, and the advice Fox gave him. In May, 1889, he instructed his broker to sell everything; but later in the same day he saw Fox, and told him he thought the price of the shares was the result of Stock Exchange gambling. Fox said that was an insult to him; and that the shares were honestly and absolutely worth £35 premium. Witness thereupon countermanded his order to the broker. The tendency was afterwards a downward one; and he lost every penny. Witness had been employed at the Leeds Forge to learn the uses of water gas. It was a complete failure as regarded steel smelting; and at one time it nearly burned the roof of the furnaces off.

Cross-examined: He bought the North British shares because he thought he would make money out of the liquidation. He could not say what day it was that Fox advised him to hold on. He had nothing to do with the first article in "To-Day;" but he wrote to Mr. Jerome thanking him for taking the matter up. He had written other letters, and had assisted the defendant with information; but he had not been paid anything. A proof of one article was shown him by Mr. Whitehead, formerly a Director of the Yorkshire Company.

Wednesday, May 5.

On the resumption of the proceedings this morning,

Sir F. Lockwood obtained permission to recall Mr. Samson Fox, and to cross-examine him in reference to the purchase of the pressed steel frame patents for £96,000, on some letters from Hardcastle, the Auditor of the old Leeds Forge Company, and in regard to a correspondence between Fox and Parker, late an Engineer Surveyor of Lloyds.

Mr. *Samson Fox*, in answer to Sir F. Lockwood, stated that Mr. John Scott, Mr. Robert Scott, Mr. W. B. Kirk, and Mr. A. S. Kirk valued the patents that were purchased by the old Leeds Forge Company in November, 1888, before the reconstruction. He had already disposed of the American rights for £100,000; and he fixed the purchase price at £96,000 for Great Britain, India, and the Colonies. He received £29,000 in cash, and the balance in preference shares, which he still held. He did ask Hardcastle to sign a balance-sheet of the Leeds Forge which the latter had not seen; but his calculation would only have been an arithmetical one. He became acquainted with Parker some time in 1877, after he had invented the corrugated flue. It was Parker's duty to give certificates as to the strength of the flues. On Dec. 31, 1885, he wrote to Parker the following letter: "At our board meeting yesterday, when I had the Scotts to themselves, I finally agreed, and they with me, on the matter that I told you of—namely, £300 any time payable that you wish it. This to continue each year so long as we can afford it from the results that come out of the patented monopoly of corrugated flues."

Sir F. Lockwood: Why were you going to pay Lloyds inspector £300 a year out of the profits on currugated flues?

Witness: We were obliged to do it.

What were you to get for it?—We were to get less obstruction from Mr. Parker in our business.

What was the nature of the obstruction that was being offered by Mr. Parker?—The fact that one of his subordinates came to our works, stayed three days to do an hour's work, and a month afterwards took patents out. Parker put this on us.

Why did you not report it to Lloyds?—We did do so later. We wanted to get on without trouble.

Were you objecting to Parker giving a formula to Browns?—We found he had given the highest formulæ for a thing which had not been tested.

Did it occur to you that if you subsidized Parker with £300 a year out of the profits on the corrugated flues, you might possibly protect yourself from his giving Browns a better formula than yours?—We had that to fight. Parker suggested it.

Did it occur to you that you were giving him an interest in your flues?—No. No doubt the condition was that, when we felt we could not pay it, he had to stand by and give it up.

Was it a bribe?—Not exactly. It was a thing he stipulated for.

Baron Pollock: Do you mean to say the proposal came from him?

Witness: It did, my Lord.

Sir F. Lockwood: You were willing to bribe him?

Witness: We had to do it.

What other object had you in bribing Lloyds inspector, except to protect yourselves from competition?—We had to get rid of his obstruction. The money was paid quarterly.

Witness (continuing) said he wrote a letter on June 21, 1896, to Parker, in which he stated that it was strange that a formula should have been given to Browns so easily, when it took the Leeds Forge four years and a half to obtain it. Asked what right he had to find fault with Lloyds' inspector in the discharge of his duty at Browns, witness replied that it was because the Leeds Forge had tested every kind of flue before anybody, and had allowed their apparatus to be used at other works.

Sir F. Lockwood: Why did you not write to Lloyds?

Witness: Parker was the man with whom every marine engineer had to deal in matters connected with boilers and engines.

If you say, as an honest trader—imagine yourself to be such—that Lloyds' inspector was betraying his trust, why not write to Lloyds?—He proposed the matter; and it had to be carried out.

Do you mean to say that he played the serpent, and you were Eve—that he tempted you?—We had to get along. I knew it was wrong; and I had determined to break through, whatever it cost us. I was disgusted with Parker giving the formula to Browns. The flue of Browns which was tested was not tested on its merits, because it was made of steel of high tension of 28 to 30 tons to the square inch. I was disgusted with the method of Parker in giving the formula.

Baron Pollock: You mean he was acting doubly and dishonestly towards you?

Witness: I do, my Lord. We were certain he was pushing this thing, because it was brought out by one of his subordinates who had to leave Lloyds. The time came when we could get on no longer with Parker; and he was spoken to very keenly. He paid back the money, and was told if anything occurred again he would have to leave Lloyds. It did occur again with another firm; and he had to leave.

Sir F. Lockwood: Was he not dismissed from Lloyds in respect of this very transaction?

Witness: No, he was let off.

When was he dismissed? Did not Mr. Martell come down to the Leeds Forge to see the letters?—Yes; when Parker had done it a second time with another firm. Whenever Parker recommended a Fox flue, he wrote saying he should expect something for it; and he was paid a commission.

Did he pass these flues as Lloyds surveyor?—No; Lloyds have a large number of inspectors over the country, and a subordinate of Parker's tested the flues at this time.

Do you mean to say that was an honest transaction?—It was dishonest on the part of Parker. We were coerced into it. It was done with the knowledge of those who were guiding the concern with me. I cannot say whether or not it is entered in any book. The Scotts are marine engineers, and know Parker well. We did not tell Lloyds, as it was a sensitive and dangerous thing. I have done nothing of the sort since; nor has anyone on my behalf.

Asked as to Leah's evidence, witness pledged his oath that it was untrue. He never met him at the offices of the Water-Gas Syndicate. The whole conversation was a deliberate invention on Leah's part.

Re-examined by Sir E. Clarke: I knew Parker nearly three years before he suggested getting some money. From time to time we supplied firms advised by Parker; and it was not an uncommon thing to pay commission for business introduced in this way. Purvis was Parker's assistant; and after being three days at the Leeds Forge, he took out a patent for a ribbed flue. A better formula was given for that flue than for ours; and we complained to Lloyds. Nothing was done in the matter for two or three years; and then the formula was amended in our favour. Hardcastle had been Auditor of the old Leeds Forge for years; and in that capacity he had to audit the accounts and check the books. Being an accountant, and not a valuer, he had nothing to do with the amount written off for depreciation. On being requested to sign the balance-sheet, he was asked to do precisely what he had been doing

every year. The accounts were checked by Hardcastle's staff from month to month.

Professor *Lewes* was re-called, in reference to a statement made by him that in October, 1889, he was of opinion that water gas was a commercial success in America. A work of his on "Service Chemistry," published in that month, was put before him, in which he stated a contrary opinion. Witness said it had escaped his memory that he had written this; but it was written in 1888, and the book went to the printers early in 1889. The passage was altered in the second edition.

This concluded the evidence for the defence, except that of Hardwick, which was to be put in on the following day.

Sir F. Lockwood then proceeded to sum up the case for the defendants. He contended that there had been ample justification for the libels. The Parker incident had an important bearing on the view Fox took of the kind of competition he had to meet. For such conduct, men had been condemned to imprisonment; and it was a precious monopoly, if Fox had to have in his pay the man who was giving certificates to those with whom he was competing in the market. Was there ever more rank dishonesty? He was not only willing to do this, but he was coward enough to put the responsibility on others. The defendants did not dispute that Fox might have some patents entitling him to use a certain process for water gas; but that process gave him no monopoly. There were other and better systems by which water gas could be produced at that time; and not a single plant put up by Fox had been successful, except that at the Leeds Forge. Subscriptions were got for the North British Water-Gas Syndicate on the faith of Mr. Donald Graham's name in the prospectus; but this gentleman never gave his consent to his name appearing. Dealing with the statement that £10,000 a year had been saved at the Leeds Forge by the adoption of water gas, the learned Counsel said there was not a single contemporaneous document to support it. It had been overwhelmingly shown, not only in the case of the Leeds Forge reconstruction, but in the sale of the patents to the Water-Gas Syndicate, that an exorbitant price had been demanded by Fox. Then there was the Stock Exchange rig, and the formation of the subsidiary Companies to excite the market. Was Fox acting the part of an honest man? He invited his learned friend to leave the issue in those terms; and if he did, he had not the slightest doubt what the result would be.

Sir E. Clarke commenced his reply by accepting the challenge of his learned friend, and reminded the Jury that there were many things of importance of which no attempt at justification had been made. The libels were persistent and malignant. It had been said that if a verdict was given against Jerome, he would have to pay the damages and costs; but he had not been in the witness-box. He (learned Counsel) wished he had, for he might then have succeeded in getting some information as to the statement that the libels were published at the request of an influential body of Yorkshire business men. He believed that statement to be a lie from beginning to end. Yorkshiremen were not cowards or curs; and if Yorkshire business men had been desirous, on public grounds, to bring the matter forward, someone would have gone into the witness-box. His learned friend had "rung the changes" for a whole day in his opening on the words "fraud, swindler, and scoundrel;" and he had applied those terms to a man whose life had been a laborious one, from whom no one could take away the credit of having made useful inventions, and who had never been obliged to admit that he had said or done a dishonest thing. Though Mr. Fox had committed a blunder in making the speech at the statutory meeting of the British Water-Gas Syndicate, there was no incident in the case upon which he would not be able to satisfy the Jury that Mr. Fox had successfully used the opportunity that had been forced upon him of challenging the investigation of his connection with the Companies, and of claiming from the Jury a verdict acquitting him.

Thursday, May 6.

After the evidence, taken on commission, of Mr. John Hardwick, of Hipperholme, had been read,

Sir E. Clarke continued his speech on behalf of Mr. Samson Fox. The learned Counsel said the defendant, through his advocate, had during the hearing of the case repeated with great emphasis the accusations brought against the plaintiff; and a man who came into Court and stated that he was prepared to prove these charges was by law called upon to give the person accused specific statements in regard to the things of which he was said to have been guilty. It was not for the defendant to make the charges, and then towards the end of the case to say that it might be that he had not proved them, but had shown that the plaintiff was not to be trusted. Juries protected a plaintiff if they found the charges were not proved; and they seldom allowed a defendant to escape a penalty because he had made some collateral charge against a plaintiff. He did not insist strongly on this point, however. Mr. Fox's history became important for the purposes of the case in 1877, when he invented the annular corrugated flue. Fox was the first man to corrugate a welded flue; and this invention, besides being a monopoly of the plaintiff, had produced a revolution in the boiler-making industry of this country. In order to obtain the fullest advantage out of the invention, it was necessary to have the welding done as perfectly as possible. In 1883, the attention of Mr. Fox was called to water gas for welding purposes; and in 1885 he sent his Engineer, Mr. Wildey, to Germany to report on it. In his report, Mr. Wildey said the heat of water gas was more intense and concentrated than that of coal gas; and that the light produced was 17½-candle power, as compared with the 14-candle power of coal gas. Mr. Fox went to Germany the following year, and found that at Essen work was being done for £21,000 which cost the Leeds Forge £41,000. At the Leeds Forge, 29 furnaces had to be kept going to repair welds; whereas this work hardly required to be done at Essen at all. Mr. Wildey and Mr. Tordoff were sent out in 1887, and they made favourable reports. In September, 1887, Mr. Fox obtained from the European Water-Gas Company a license to use water gas for welding and lighting at the Leeds Forge; and in March of the following year the Leeds Forge entered on the constant and habitual use of water gas for these purposes, and had continued to do so up to now. There was no question that at the time the reduction of the cost of working was the only thing in Mr. Fox's mind. The excellence of the weld had been completely demonstrated by the evidence; and instead of 29 furnaces, only two were now required. During 1888, the people at the Leeds Forge, who were no novices, were certain to keep an account showing how much the saving was that was effected, and whether or not it corresponded with the enormously successful results at Essen. Anyone could see with half an eye that with such a reduction in the number of furnaces there must be an enormous saving somewhere. Passing on to refer to the gift to the Royal College of Music, the learned Counsel said Sir Frank Lockwood had gibed at the idea that plaintiff should have any interest in music. Yorkshire was a county famous for music; and he (Sir E. Clarke) was not aware that the fact of a man being engaged in mechanical operations should debar him from taking an interest in that art. Why he should not do so required the Editor of "To-Day" to explain. In this connection, the attack of the defendant upon Fox was of a gross and wicked nature, when it said that, if the Prince of Wales had known as much about Samson Fox as he was told about Baron Grant, he would not have countenanced him at the opening ceremony at the College. The defendant opened his attack by comparing Mr. Fox as a bird of a feather with Baron Grant, and denouncing him as giving a portion of his spoil to the College. After referring to the circumstances attending the gift, which was promised and agreed upon long before the Water-Gas Companies were brought out, the learned Counsel dealt with the question of the validity of the patents; the charge brought against Mr. Fox being that he knew they were invalid. Having obtained a report from Mr. King, an authority on patents, the plaintiff agreed, on Sept. 15, 1888, to purchase the water-gas patents for this country for nearly £40,000. They were assigned to him in February, 1889, and by him to the British Water-Gas Syndicate in March. Yet the defendant alleged that they had not been transferred at all. It was possible that a man might buy patents he believed to be worthless, in the hope of palming them off; but in this instance experiments had been made at the Leeds Forge, and the persons proposed to be deceived were on the spot. Half of the Fox corrugated flue patents belonged to the Leeds Forge Company; and in 1887 Mr. Fox, instead of taking royalties for his other half, took shares in the Forge Company, which was involving him still more in the fortunes of the Company. He also sold his pressed steel frame patents to the Company. The prospectus of the new Leeds Forge Company was issued on New Year's Day, 1889, and the defendant said it was fraudulent. It was asserted that it was inaccurate to say that they had a practical monopoly of their own specialities, as the prospectus stated. Not merely was the prospectus not fraudulent, but it was absolutely true. Messrs. Brown never made annular corrugated flues during the life of the Fox patent, but simply ribbed flues. Did any of the shareholders of the new Leeds Forge Company complain of misrepresentation? Not one. They had the means of detecting it, if the statements were untrue as to the assertion that £10,000 a year had been saved at the Leeds Forge by the adoption of water gas. The papers which would show this result had been lost; but Mr. Gordon's report was equally good. As to Mr. Craven's valuation of the property of the old Company at £529,000, there was no suggestion made against it until Mr. Craven was dead. He was a man of the highest reputation as a valuer. When the Directors received this valuation, was it a fraud to put it before the public? It was said that the last balance-sheet of the old Company had put the value of the property at less than £300,000; but the valuation of a business for sale as a going concern was very different. It was stated that Mr. Craven put on a monopoly price when not entitled to do so; but to say that Mr. Fox put forward a fraudulent prospectus because he was accepting the valuation of the most experienced valuer in Leeds, was really going too far. All the Directors were on trial with regard to the prospectus. The average profit since the reconstruction was £30,000 a year; and in the year after they started, they made £77,000 and paid a dividend of 17½ per cent. It had been suggested that the vendors' shares given to the members of the little Syndicate were not saleable; but the evidence of Lear showed that he had purchased some at 1½ premium. As to the prospectus of the British Water-Gas Syndicate, Mr. Paddon, who was called as an expert for the defence, said that there was only one passage with which he would differ in opinion—namely, the statement that the patents would enable the Company to command the market; and he said he did not see anything else to which he would take exception. This was the evidence of the first witness called to prove that the prospectus was fraudulent. Mr. Jerome had said that it teemed with misstatements, suggested the false, and contained the "good downright thumping lie." But his own expert could only say that one statement implied something from which he differed in opinion. Mr. Woodall, another expert called for the defence, said that the prospectus was intended to convey the idea that there was a monopoly of the manufacture of water gas in the hands of the Syndicate. But he was interpreting the words "command of the market" as meaning a monopoly. It was further alleged that it was untrue to say that water gas could be produced for 4d. per 1000 cubic feet, and that Sir Douglas Fox was hoodwinked in giving the certificate. Sir Douglas Fox's assistant went down to the works to make the observations; and he had stated that they were correct. The Water-Gas Syndicate was an immediate and a great success. The reason it had not continued to be successful was that fatal accidents had occurred at Windsor and Hull through water gas being inodorous. The statement that Mr. Fox formed a pool to rig the market, and then unloaded while all the time he was advising his friends to buy, had no foundation. Mr. Fox had sworn that he never sold a share on the Stock Exchange at all. Then the plaintiff was accused of settling actions in which fraud was alleged against him. But if the Notts and Derby Company thought they had any case of fraud against Mr. Fox, they would not have settled for £15,000 the action which the British Water-Gas Syndicate brought against them. The allegations of fraud in *Christie v. Fox* absolutely collapsed; and the charges brought against Mr. Fox were unequivocally withdrawn.

Friday, May 7.

Sir E. Clarke, in concluding his address for the plaintiff, impressed on the Jury that the defendants could not come into Court and say: "Supposing the charges in the libels are untrue, that there is no foundation that Fox rigged the market and made £30,000, and all the accusations against him fail; never mind, we ask you to say that, because of something in matters anterior to those we are discussing, you ought to give no damages at all." Grave charges had been made against the plaintiff. If they were not true, ought not the man who had persisted in charges up

o the present time be made to pay for this attack on the plaintiff? He should say very little about damages. Money damages would not easily compensate for what had happened to the plaintiff—for the injury that must have been done to his surroundings and friendships. Mr. Fox had had to stay in Court hearing the charges brought out with all the force and energy of which Sir Frank Lockwood was capable, without any desire to lessen the sting, or to blunt the point of that which he was directing against him. Nothing would compensate for such an experience as that; and he asked the Jury to give fair and reasonable damages to Mr. Fox, such as would express their opinion of the real merits of the case they had been investigating.

Baron Pollock then summed up the case. He said the case had taken longer in hearing than any action for libel he, in the course of fifty years' experience, remembered; but in saying this, he did not imply that one moment had been unnecessarily expended. An action for libel usually involved one piece of conduct or a series of personal conduct on the part of a plaintiff, which could be brought within a very narrow compass. But in the present case, the value of patents, their validity, the working of a great manufacturing business, the formation of Companies, the dealings in shares of those Companies, the amalgamation, and other matters had been brought out—all of which were necessarily of importance upon the question the Jury were about to decide. This made it the more important for them at the earliest moment to endeavour to fix in their mind what was the exact issue between the parties. This was not an action brought against Fox on a charge of fraud by a person seeking to set aside a contract on account of that fraud. It was brought by Fox against a person who was a perfect stranger, who had written the libels, and stood by them throughout the trial, and by the consequences which might follow. It was not necessary for him at this stage of the case to read to the Jury the whole of the libels. He need not point out, as Judges sometimes had to, whether this was a libel or not, as the language was so severe that it was not worth saying a word on the point. The Jury must endeavour, in following the libel and justification, to extract what was the full and fair import of each particular charge. There was no question that, up to a certain point, the plaintiff was earning his living in perfect honesty; and, to his credit be it said, from a lad earning a few pence a day he became a large employer of labour, and was able to give a considerable sum of money to the Royal College of Music. The decision rested with the Jury, and was theirs entirely. He had no more to do with it than he had to do with something going on in another Court. They had about as important a matter to determine as could fall to the lot of a Jury; and they must be guided by many considerations. One of them would be, What did they intend to put upon each particular transaction, and was it a fair standard of commercial morality. Mr. Fox said water gas was a commercial success. Then came the great question, what was the date on which he said this? It might be that Fox honestly believed water gas to be a good thing. Otherwise why did he send to Germany three times, and pay large sums for a licence, if he thought it was all moonshine? When did it come upon him that, after all, water gas was not such a good thing as he had hoped it to be. Did it come upon him before the prospectuses were issued? In this case, the plaintiff did not stand alone. He employed a man named Cottam. It was said that Cottam was a scoundrel who could not appear in the witness-box. The Jury must think of what Cottam was then. As to saying the plaintiff could not call Cottam, there were a good many people of very high position in finance and commerce who could not call people they dealt with in financial matters. With regard to the use of water gas, it had been found that it stood better for welding than anything else. In support of this view, there was the evidence of the plaintiff, the Managing Director, Sir Douglas Fox, his assistant, Mr. Watson, Mr. Stewart, of the firm of Stewart and Clydesdale, Mr. Spencer, Mr. Pollard, and Mr. Tordoff; while for the defendants, Mr. Simpson, Mr. Moss, Mr. Greg, and Mr. Vint deposed to it being unsuccessful. Then came the important matter in which Fox was said to have settled actions in which fraud was alleged. Mr. Donald Graham, a clear-headed Scotchman, connected with a very large firm in Glasgow, was to have joined the Board of the North British Water-Gas Syndicate; and the prospectus was issued with his name on the directorate. But this gentleman had retired, and some shareholders would not go on; and actions were then brought which were settled one by one. It seemed that if there had not been fraud on the part of the North British Directors, the Company must have lost those actions, because undoubtedly the shareholders joined on the faith of Mr. Graham being a Director. This tempered the question by the defendants' Counsel: "Why did you not go on with those actions?" But it was not as if the charges had been made in public—they had only come from the pleader's chambers. The same thing arose in the more important action of the Notts and Derby Company, who declined to pay the consideration-money to the parent Syndicate, on the ground of fraud. The Notts and Derby Company, however, instead of paying £50,000 in cash, settled the action for £15,000, and gave up the patent rights. The Jury ought to be very careful in dealing with that. Then came the correspondence between Fox and Parker; and that gave him great pain. No one who was an honest man of business could hear without pain of the practice of giving people who had a position of trust and honour to discharge, money which would lead them astray. Many people in this country, who in other respects conducted their business honestly and truly, paid what they called "commissions," but which were in truth bribes; and bribery was the cankerworm of the honesty of those people. It was done in other countries more than it was in England; but Judges always denounced the practice very strongly. He did not think he should have been doing his duty if he had not spoken of it in the plainest terms. Still, it had nothing to do with the transactions connected with the case. Fox said he had to do it or Parker would have turned rusty; and the Leeds Forge might have lost the whole of their business. Supposing there had been no water gas and no Companies, would the same thing have happened? He should say it would. Beyond showing that the plaintiff was a man who would do such a thing, the issue was of very little importance. If the Jury found substantially that the libel was true, their verdict would be for the defendant; and however much they might regret—as everybody must—that such a verdict had to be arrived at, it was the duty of the Jury to give it if they thought the evidence led that way. If, on the other hand, they came to the conclusion that the libels were not true, or that there were some material parts of them which were not true, then the plaintiff would be entitled to a verdict on that part. Then their only consideration would be as to what damages the plaintiff was entitled to.

The Jury retired at three o'clock to consider their verdict; and after an absence of two hours, returned into Court. In answer to a question by the Associate,

The Foreman of the Jury said their verdict was for the plaintiff, with damages one farthing.

Sir F. Lockwood said he would make an application as to the costs on Monday morning.

Monday, May 10.

After the luncheon interval to-day,

Sir F. Lockwood applied on behalf of Mr. Jerome that, under the circumstances of the case, the plaintiff should be deprived of his costs, and be ordered to pay those of the defendant. The learned Counsel said Mr. Fox commenced an action to clear himself, and to recover damages by reason of the undoubted aspersions cast on his character; and, after a trial lasting sixteen days, the Jury came to the conclusion that a portion of the libel was not justified, and found a verdict for the plaintiff, but only gave him one farthing damages. This was a distinct intimation that, in the opinion of the Jury, the action ought never to have been brought. He submitted, therefore, that not only should the plaintiff be deprived of his costs, but that he should pay those of the defendant.

Sir E. Clarke contended that the Jury had given their verdict against the defendant on the issue whether the libel was justified, and that his Lordship should allow the law to take its course. In the libels, which extended over a considerable period, Mr. Fox was repeatedly challenged to go into the witness-box and deny the statements made against him; and this he had done. Where a justification was put on the record, the defendant took the duty of proving that the libels were true; and if he failed, he failed on the issue he had raised. The proper consequences were that he should pay the costs. He asked that the plaintiff should get such costs as the law permitted, and also that an injunction might be granted to restrain the defendant from further publishing any copies of the paper containing the libels.

After a reply from Sir F. Lockwood,

Baron Pollock decided to deprive the plaintiff of his costs; the defendant undertaking not to republish the libels, or any part thereof, and if he published them in substance it would be within the injunction.

The parties will therefore pay their own costs.

DUBLIN POLICE COURT.—Thursday, May 6.

(*Before Mr.* Swifte.)

The Testing of Gas on Public Holidays.

To-day the Dublin Corporation summoned the Alliance and Dublin Consumers' Gas Company for having on two occasions—the 16th and 19th of April, 1897—made default in having "failed and refused to give the Local Authority and their Gas Examiner (Mr. T. J. Cotton) access to the testing-place provided for the testing of gas supplied to the complainants by the Company, in conformity with 34 & 35 Vic., cap. 41, and did not afford facilities for the proper execution of the said Act, whereby defendants were liable to a penalty not exceeding £5 for each default."

Mr. Macinerney, Q.C., appeared for the Corporation; Mr. J. Gordon, Q.C., represented the Company.

Mr. Macinerney said the summons was taken out against the Company for not permitting the Corporation Gas Examiner to have access to the gas-testing station on the 16th of April, which was Good Friday, and the 19th of April, which was Easter Monday. On Thursday, the 15th of April, the Town Clerk wrote to the Secretary of the Company (Mr. W. F. Cotton, J.P.) stating that it was the desire of the Corporation that their Examiner should test the gas during the Easter holidays. Mr. Cotton presented himself on Good Friday; but he was refused admission. He went the next day and said it was his desire to examine the gas on the following Monday; but he was told that he would not be allowed to do so. On Monday he found the place closed. The Corporation were proceeding under the Gas-Works Clauses Act, 1847, which prescribed that the gas-testing station should be open on "any and every day of the year" for the purpose of enabling the gas examiner of the local authority to test the illuminating power of the gas; and he submitted that, having regard to the provisions of the Act, his Worship was bound to impose a penalty for the breach thereof.

Mr. *T. J. Cotton* was called; and he confirmed the learned Counsel's statement.

In cross-examination by Mr. Gordon, witness said he believed it was not the general custom to keep gas-testing stations open on Sundays or Good Fridays; but it might be done on special occasions. It was the practice to keep open on Sundays from 1888 to 1892. He had tested on Sundays; but he was not sure about Good Friday. From 1892 to 1896, the station was not open on Good Friday or Christmas Day because they were in a state of transition during that period, and there were disputes with the Corporation. He began to test again at midsummer. It was only in September last that the Gas Committee asked to have the testing resumed on Sundays; and the Company replied that they would give facilities for this being done. Nothing was then said about holidays. On the 24th of December, the Committee wrote asking to have the station open during the Christmas holidays. He did not go there on Christmas Day; but the station was closed. He did not suggest to the Committee to take the present action. If the Company gave the Corporation a key of the station, there would be no difficulty. From Thursday before Easter till the next Tuesday were holidays at the City Hall, but not in his department. It was on the Thursday evening that the Town Clerk wrote the letter to the Secretary of the Company, asking that the station might be kept open all the year, holidays included.

Mr. Gordon: And Mr. W. F. Cotton replied to the Town Clerk as follows:—

I am in receipt of yours of the 15th, asking me to give instructions to have the public testing-station kept open during all days throughout the year, holidays included. I am directed to point out that in 10 place, save in Dublin, so far as we can ascertain, are the public testing-stations kept open

on Sundays. We have, however, for some months past, in compliance with the wishes of your Committee, kept the testing-station open on Sundays; thus keeping some of our staff at work, and depriving them of the weekly holiday. It now appears that your Committee are not satisfied with this, but require that the station should be kept open on Good Friday, Easter and Whit Mondays, Christmas Day, and St. Stephen's Day, all of which are universal holidays. In London, where the testing of gas is carried out more rigidly than in any place in the United Kingdom, the testing-stations are always closed, not alone on Sundays, but also on the days referred to. We understand that, as a rule, the Corporation close all their offices, not only on those days, but on additional days—for instance, from the Thursday before Easter. When your letter was addressed to us, all your offices were closed until the following Tuesday. My Board would ask your Committee to reconsider this matter. They cannot think it possible that the Corporation will insist upon their complying with so unreasonable a request.

Was any answer sent to that letter except the summons?

Witness: No answer, as far as I know. There are twelve or fifteen—perhaps eighteen—members of the Gas Committee; and I believe six were present when it was decided to issue the summons.

Will you undertake to say that there were no more than Alderman Mulligan, Mr. Kennedy, and Mr. Downes?—No; I cannot say that.

Mr. SWIFTE: How many are necessary to form a quorum?

Witness: Three.

In reply to further questions, witness said no doubt less gas was consumed on Sundays and public holidays than on other days.

Mr. GORDON, in stating the case for the defendants, said all Acts of Parliament should have a reasonable construction. His Worship would hear from Mr. W. F. Cotton that since 1892 no testing at all had taken place on Sundays. In September last, the Corporation requested that the station should be opened on Sundays; and the Committee opened it. Nothing was then said about holidays; and it was only on Christmas Eve that they had notice that it would be necessary to keep the place open during the Christmas holidays. He did not like to attribute motives, but he should say that it looked like an attempt to catch the Company. Nothing was then said about the Easter holidays; and on the 15th of April a notice was again issued by the Corporation, after office hours, to have the station kept open during the Easter holidays, though from that day to the following Tuesday the Corporation kept their offices closed in order that their own officials might have a holiday. He was bound to say that, in his opinion, this was a very unreasonable and unmeaning proceeding; and if his Worship held that there was any contravention of the law, the penalty imposed should not be more than the smallest coin of the realm. The notice did not reach Mr. Cotton until Good Friday, and then it got into his hands by accident. In the meantime, Mr. Bryant, who was in charge of the testing-station, had received leave of absence for Good Friday and Easter Monday. On the question of law, he submitted that the default referred to in the Act meant wilful default, and that therefore no penalty should be imposed, as it was clear there was no such default in this case. If the Corporation had any complaint to make against the quality of the gas supplied by the Company, they had been several times challenged to come into Court and test the matter; but, having failed in the Courts, and elsewhere, he supposed Mr. Thomas Cotton thought he had his chance in bringing these proceedings, which he (Mr. Gordon) felt bound to characterize as harsh and unreasonable, having regard to the letter of the Company's Secretary. Even if his Worship should be of opinion that default—even wilful default—existed, then he thought the penalty should not be more than, as he had said, the smallest coin of the realm. He would examine Mr. W. F. Cotton on the question of custom.

Mr. MACINERNEY said he did not raise any question about custom. It was simply a question of the effect of the section.

Mr. GORDON remarked that, after what had been fairly said by his friend, he would not examine Mr. Cotton.

Mr. SWIFTE, in giving his decision, said it was clear, by the Act of Parliament, that the station should be open every day. The Act said, to emphasize it, "any and every day." It might be a hard case for the officials, but hard cases made bad law. He thought it would have been much more courteous if the Corporation had answered Mr. Cotton's letter before issuing the summons. However, as Mr. Thomas Cotton had stated, they wished to have a judicial decision on the matter once for all. The case, however, was merely one for a nominal penalty—the Company having had very short notice; and what he proposed to do was to inflict a fine of 5s. in each case.

Mr. MACINERNEY pressed strongly for costs.

Mr. GORDON contended that costs should not be allowed, having regard to the fact that the summons was issued before any reply was given to Mr. Cotton's letter which he could lay before his Directors.

Mr. SWIFTE said that, as the Company had raised a question of law in the case, he would give costs, but would only allow three guineas.

The Gasholder Tank Litigation at Stockport.

Our readers may remember that about three years ago litigation took place between the Corporation of Stockport and a firm of Contractors in Liverpool (Messrs. Holme and King), in regard to their contract for the construction of a gasholder tank for the Corporation. The action was referred to the Official Referee, who made an award which was unsatisfactory to the Contractors; and they applied to the Queen's Bench Divisional Court to have it sent back to him, or judgment given for them. The Court (consisting of Justices Mathew and Collins) set aside the award of the Referee. Thereupon the Corporation appealed, with the result that his judgment was restored, with costs against the plaintiffs. The matter was then taken to the House of Lords, who on Feb. 25, 1896, made an order remitting the action to the Referee. Last Tuesday, however, upon the joint petition of the appellants and respondents, this order was discharged, and the appeal dismissed on terms agreed upon by the parties.

Embezzlement by a Gas Company's Collector.

At the Central Criminal Court, on Monday last week, Charles Hammond Croxford, 25, pleaded "Guilty" to embezzling several sums of money the property of his employers, The Gaslight and Coke Company, and also to falsifying the Company's accounts. The accused was charged at the Westminster Police Court on the 12th ult., and committed for trial (see *ante*, p. 891). Mr. Humphreys prosecuted; Mr. Purcell appeared for the prisoner. It was stated that Croxford had been appointed, at a salary of £75 a year, to collect the money deposited in the prepayment meters in use in a large portion of the Fulham district, to give receipts therefor, to enter on a counterfoil the amounts received, and to pay the cash the same day into the London and South-Western Bank, Walham Green. It sometimes happened that the consumer would be out when the collector called; and in such cases the letters "N.A."—meaning "No Admittance" were to be written on the counterfoils. The accused had taken some £60 or £70, and endorsed the counterfoils "N.A."; and he had also so falsified the Company's accounts that as many as twenty clerks had to be engaged in putting them right. The fraud had gone on for a long time before it was discovered. Prisoner called at a house in Cranbury Road, Fulham, received 10s., and gave a receipt. He then placed the initials "N.A." on the counterfoil. This was on the 5th of December; and on the 7th he told a man who accompanied him to carry the bag containing the coppers, to meet him at a certain spot. The man went; but the prisoner had absconded, having heard that the Company's officials had been making some inquiries about his accounts. Mr. Purcell, in mitigation, pointed out that the prisoner was a young man, that he had considerable temptation put in his way, and getting into bad company yielded to it. He was sentenced to twelve months' hard labour.

The Assessment of the Cardiff Gas Works.

A Special Sitting of the Glamorgan Quarter Sessions was held at Cardiff last Friday week—his Honour Judge Williams, Chairman of the Sessions, presiding—for the purpose of hearing an appeal by the Cardiff Gaslight and Coke Company against the rateable amount fixed by the Assessment Committee of the Cardiff Union. Mr. Edward Boyle and Mr. Rhys Williams appeared for the appellants; and Mr. Marshall, Q.C., Mr. Arthur Lewis, and Mr. St. John Francis-Williams for the respondents. When the case was called, a consultation took place between the parties; and after a rather lengthy conference, a compromise was decided upon. Mr. Boyle mentioned that the settlement arrived at was that the gross value should be reduced from £30,484 to £26,550; and the rateable value from £17,222 to £15,000. The apportionment was as follows: In the parish of Penarth, the gross would be reduced from £1160 to £1010, and the rateable from £928 to £808; in the parish of Llandough, the gross from £112 to £97, and the rateable from £56 to £49; and in the parish of Llandaff, the gross from £234 to £203, and the rateable from £187 to £163. They had also agreed that all the assessments in the borough should be reduced *pro ratâ*, so that the total gross and rateable values are reduced respectively from £30,484 to £26,550, and from £17,222 to £15,000, and that the appellants would not on this valuation raise any objection as to the amount of difference between the gross and the rateable values. The arrangement was accordingly sanctioned; no costs being given to either side.

Increased Sale of Gas at West Bromwich.—The Gas Committee of the West Bromwich Town Council report that the consumption of gas during the year ended March 31 last was 231,538,675 cubic feet—an increase over the previous year of 16,533,075 cubic feet. The gas-rental for the same period was £29,328—an advance of £2029.

The Assessment of the Torquay Gas-Works.—The Newton Abbot Union Assessment Committee have intimated to the Torquay Gas Company that the assessment of their works has been reduced from £3500 gross rental and £2800 rateable value, at which it was placed by the Overseers, to a gross rental of £2400 and a rateable value of £1920.

The Royal Commission on London Water Supply.—Last Friday's "London Gazette" contained a notice by the Home Secretary stating that the Queen had appointed a Commission to consider the subject of the London Water Supply. The names of the Commissioners, as published in the "JOURNAL" last week, are given; and then the terms of reference, already noticed in our columns, are set forth.

The "Diamond Jubilee" of the Incorporation of the Cardiff Gas Company.—The Cardiff Gas Company this year celebrate the sixtieth anniversary of their incorporation; and the occasion is to be marked by appropriate festivities. During the 60 years, there have been but four Chairmen. The present occupant of the position (Mr. C. H. Williams) is the son of the founder and first Chairman of the Company.

The Winchester Gas and Water Company and their Oil Main.—The Winchester Town Council have consulted Mr. A. Macmorran, Q.C., as to their position with regard to the action of the Winchester Gas and Water Company in laying a main for the supply of oil to their gas-works; and the following opinion has been given: (1) The power of breaking the streets conferred by section 6 of the Gas-Works Clauses Act, 1847, is for the purpose of laying pipes, conduits, service-pipes, and other works, and of laying sewers for carrying off waste liquids. In my opinion, the pipes, &c., referred to in the section are pipes for the supply of gas only. The section does not give a general power to lay pipes for any purpose. This is shown by the express reference to sewers for waste liquids, which would be unnecessary if the powers were general. I consider, therefore, that the Company had no power to lay down the main for conveying oil to their works, though that oil was to be used in the manufacture of gas. I attach no importance to the fact that water gas is a new gas. The Gas-Works Clauses Act, 1847, is not limited to any particular kind of gas. (2) As the acquiescence of the Corporation in the laying of the main was founded on the mistaken belief that the main proposed to be laid was an ordinary main for supplying gas, I do not think the Corporation are debarred, on the ground of acquiescence, from taking any steps they may think fit in respect of the wrongful laying of the main in question; and, in my opinion, the Corporation may obtain an injunction to restrain the Company from continuing to keep the main in the street, or at all events to restrain its being used for any purpose other than the supply of gas. (3) I am not aware of any penalties which could be recovered under the circumstances." As a result of this opinion, the Town Council have resolved to insist on the Company either paying an annual rent for the main or removing it.

MISCELLANEOUS NEWS.

THE EXAMINATIONS IN GAS MANUFACTURE.

The Question Papers.

The examinations in "Gas Manufacture" were held by the City and Guilds of London Institute last Tuesday; the following being the questions put by the Examiner (Mr. Alfred Colson, M.Inst.C.E.):—

ORDINARY GRADE.

1. What do you understand by the carbonization of coal, and in what way is it conducted? 2. What are the objects of "condensation," and at what point in gas manufacture is it mainly effected? 3. For detecting impurities in coal gas, what would you employ, and how? 4. What is meant by "illuminating power," and how is it arrived at? 5. Describe in what way "pressure" and "exhaust" are ascertained and self-recorded. 6. In what way is the pressure under which gas is supplied controlled at the works? 7. Describe the incandescent gas-burner. 8. How would you test spent oxide of iron for sulphur? 9. Why is cannel coal used in gas manufacture, and what could be substituted for it? 10. What precautions are necessary in laying mains and services?

HONOURS GRADE.

1. Describe and illustrate by sketches a setting of eight single retorts heated by a regenerator furnace, and explain the scientific principles involved. 2. Describe the process of carbonization of coal and the effects of temperature upon the products obtained thereby. 3. How would you effect the complete purification of gas as far as at present practicable? Particularize the impurities to be dealt with, and your method of treating each. 4. Give sketches, plan, section, and elevation of a purifier 28 ft. by 20 ft., and 6 ft. deep. 5. How would you enrich gas without the aid of cannel? Describe the process you would employ. 6. Describe either a system of stoking machinery or a method of setting retorts by means of which retort-house labour may be reduced. 7. How is sulphate of ammonia manufactured from ammoniacal liquor? Describe and illustrate by sketches a method of such manufacture. 8. For what purpose are the station meter and governor employed? Describe, with sketches, each apparatus. 9. Describe some form of carburetted water-gas plant. 10. What apparatus would you use, and in what way, for the analysis of producer and flue gases?

The maximum number of marks obtainable was 30 for each question in both grades.

IMPERIAL CONTINENTAL GAS ASSOCIATION.

The Half-Yearly Ordinary General Meeting of the proprietors of this Association was held last Tuesday, at the Cannon Street Hotel, under the presidency of Mr. T. H. GOODWIN NEWTON.

The SECRETARY (Mr. R. W. Wilson) read the advertisement calling the meeting, and subsequently the following report of the Directors:—

The present half-yearly ordinary general meeting of the proprietors has been convened in conformity with the Association's Acts of Parliament, for the purpose of receiving a report from the Directors upon the affairs of the Company, and of declaring a dividend for the half year ended the 31st of December last.

The following summary shows the results of the Association's operations during that period: The quantity of gas made in the half year ended the 31st of December last was 4797 million cubic feet; the quantity made in the corresponding half year of 1895 was 4591 million cubic feet—being an increase of 206 million cubic feet, or at the rate of 4·47 per cent. The total number of lights on the 31st of December last was 2,496,575; and at the close of the corresponding half year of 1895, the number of lights was 2,328,313, which gives an increase of 168,262, or at the rate of 7·22 per cent. The entire length of mains laid on the 31st of December last was 1890 miles; the length of mains laid on the 31st of December, 1895, was 1834 miles—an increase of 56 miles. During the half year under review, the number of consumers has increased by 11,398; making the total number 194,172, as compared with 175,384 at the close of the corresponding half year—an increase of 18,788, or at the rate of 10¾ per cent.

As the above figures indicate, the volume of the Association's business has grown at a somewhat higher rate than usual; but the profit earned has not increased in a similar proportion—being but slightly in excess of that for the corresponding half year. The principal reason of this is that the greater part of the increase in the consumption of gas is due to its extended use for cooking, heating, and industrial purposes. As reported on a previous occasion, gas so used is sold at a lower price, and consequently leaves a narrower margin of profit.

The values of coke and tar exhibited some improvement; but not sufficient to counterbalance the extra cost for coal and the decrease in the revenue derived from the sale and treatment of ammoniacal liquor.

The plant and mains at all the stations were maintained in a due state of efficiency.

To meet the increasing requirements for gas at Frankfort, additional producing and storage plant was necessary upon the Bockenheim Works. A new tank is already well in hand; and the gasholder for it will be ready in time to meet the demands of next winter.

The Directors have sold land for which there was no further use at Amsterdam, Toulouse, and Stolberg.

At the general meeting held last May, the proprietors were informed that the authorities of the City of Amsterdam had, under the terms of the Association's contract with them, given the requisite notice of their intention to take over the works by purchase on the 1st of August, 1897. Since then, however, the Directors have suggested to the authorities conditions for an amended contract; and the above-mentioned notice remains in abeyance pending the negotiations.

In pursuance of the Board's policy to comply as far as possible with the wishes of the authorities of the towns and districts which they supply with gas, the Association, in co-operation with the Allgemeine Electricitäts Gesellschaft, of Berlin, have undertaken the supply of electric current in Zehlendorf, a suburb of Berlin, for a period of five years. The Board have also taken a larger interest in the Electric Lighting Company at Lille.

The Directors desire, in conclusion, to draw the attention of the proprietors to the accounts for the half year ended the 31st of December last. These have been duly audited; and from them the Directors have, in accordance with the provisions of the Companies Clauses Consolidation Act, prepared a scheme showing the profit of the Association for the half year, and the portion thereof applicable to the purposes of dividend, which they recommend now to be declared—viz., a dividend of 5 per cent. for the half year ended Dec. 31 last, payable, free of income-tax, on and after Tuesday, the 11th inst.

The Directors who go out of office by rotation are Francis Bassett, Esq., Sir James Carmichael, Bart., and Thomas Henry Goodwin Newton, Esq. These gentlemen are eligible for re-election, and offer themselves accordingly. The Auditor who goes out of office by rotation is Sir Joseph Sebag Montefiore, who is eligible for re-election, and offers himself accordingly.

The CHAIRMAN, in moving the adoption of the report, said he would call their attention to its salient features, avoiding as much as possible the bewilderment of figures. They would observe that distinct progress was reported, as compared with the corresponding half year—whether measured by the increase of gas made, by the number of lights and of consumers, or by the length of mains. He preferred to take the first of these—that was, the gas made—as the basis of comparison. Thus measured, the rate of increase was the smallest—namely, 4½ per cent.; but it was the most accurate for their present purpose, without elaborate corrections and explanations. This 4½ per cent. rate of increase was greater than it had been in any other half year since 1891. The previous half year, they might remember, it was 3½ per cent. Its special value was in showing that for them abroad the tide had really turned whose ebb had marked what he had ventured to foretell would be the temporary decrease in the rate of growth of gas consumption caused by the adoption of the so-called incandescent burners and by the use of electric light. In England, if the cost of an article of utility or even of luxury was cheapened, the tendency at once among all classes was to use more of it—up to at least the amount formerly spent upon it. Abroad this tendency was shown much more slowly. The satisfaction of small domestic economies must be first enjoyed, before the idea of extended use occurred. The report pointed out that the 4½ per cent. increase in gas made was not reflected in the profits. The reason for this was that much of the increase had been in gas used for heating, and not directly for lighting purposes; and such gas was sold abroad at lower prices. The explanation that used to be given for making this difference in price was that it was all "day gas," and improved the load-factor of gas-works. He did not think this reason for making a great difference in price at the present an altogether satisfactory one. The demand for gas for both purposes was now much more concurrent. Indeed the economics of fuel gas when understood would in the near future undoubtedly call for special consideration on the part of gas companies. They were aware that it was but a small fraction of the coal raised which gas-works at present used; and of so much of the remainder as was employed domestically, nine-tenths of its heating value went up the chimney. Of course, they had used more coal in the half year under review; and he was glad to say they had paid no more per ton for it. But the great by-product, coke, though showing an improvement, did not quite come up to their anticipations. There was an increase, however, in the receipts for tar, which fully compensated for the further fall in those for ammonia. On the subject of this by-product, he was very glad to see, within the last few days, that the lead taken on the Continent had been followed in England, by forming an association to demonstrate to agriculturists the special value nitrogen had for their crops in the form of sulphate of ammonia, as compared, for instance, with nitrate of soda. So much depended upon the form in which a "medicine" was exhibited, as the doctors said. So far, they had been comparing themselves with themselves; but for one moment, and in one particular, he would compare themselves with others. Great Britain had the credit of being the home of cheap gas. But they might take it from him that the gas-rental received by this Association on the Continent was at a lower rate compared with what the Association paid for coal, and even for net coal—that was, coal less residuals (where the factor of good management came in)—than was the case in London, in its suburbs, and in the country at large, whether they took the aggregate of gas companies or of self-supplying corporations. He did not mention this, so far as it depended upon the good management of their Association, boastfully, but to illustrate that their constituents—the consumers—had nothing to gain by substituting single companies or municipal corporations for the Association, which was practically an association of gas companies, where union was strength—a power, in ways he need not stay to specify, for economic production for the benefit alike of the consumer and of the gas proprietor. From this low rental, however, they had still sinking funds to provide; and in places where the consumer thought the price he paid a high one, the fault would be found to lie more with the result of impolitic restrictions put upon the Association by municipal authorities, than with the Association itself. The report referred to the electric light. Now the electric light was the best handmaid gas ever had. It raised the standard of demand for light in a town; and gas, particularly incandescent gas lighting, of which many used to be afraid, supplied that demand. Whether a gas company in localities where it was allowed to do so, should become an electric light company, was a question the policy of which had to be determined by very varying circumstances. He could wish that he might now be spared any reference to their position at Vienna, for anything said at their meeting might come to the knowledge of those more interested in the municipal undertaking there than were the proprietors here; and it might be misunderstood or misrepresented, to the damage of the Association and, he firmly believed, to the prejudice of the gas consumers at Vienna. At the last meeting, he entered upon this subject at considerable length, and explained the position up to that time very fully. He now merely proposed to refer to what had since taken place, as he would not add anything to that statement—except, possibly, to emphasize that there was an evident danger to their interests, which they must bear in mind, in what he might venture to term the political aspect of the question of municipal gas-works, in furtherance of which economic conditions might be pushed aside by purely sentimental ones—the notion, in fact, that gas at a high price from municipal works was better than that at a low price from a company's works, or even from works which had been possessed by a company. It was difficult to understand such a view; but it was one that had to be reckoned with. Coming to the events of the past six months, a most liberal offer for a new contract was made to the party now in power; but it was rejected by the latter without discussion. On the occasion of this offer, and again subsequently, deputations of the Directors, including himself on the first occasion, visited Vienna. Their very varied interests in 33 of the contracts with old Vienna and its suburbs, threatened

by the Town Council, had been the subject of frequent consultations, both in London and Vienna, with their official representatives there; and on every opportune occasion they had expressed their willingness to consider any reasonable proposal made by the authorities; when he added that their rights and obligations under certain of these contracts were already the subject of several appeals to the Law Courts in Vienna, it was a sufficient reason in itself for reticence in public with regard to the matter. Such was the information which could prudently be given with regard to Vienna; and he must repeat the warning he gave on the last occasion—that apparently innocent inquiries might be very detrimental under present circumstances. At their last meeting, he had to announce the retirement and subsequent death of Mr. Leonard George Drory; and now he had to chronicle the retirement of an officer whose presence had been familiar to them—the Accountant, Mr. Izaak Walton. That gentleman had been with them, man and boy, over 53 years; and he said "man and boy," because he hoped Mr. Walton was still young enough to carry into retirement the prospect of a long enjoyment of the pension the Board had accorded to him. He had also to mention the very sudden death of their Solicitor, Mr. Maresco Pearce; and that they had appointed to succeed him Mr. Arthur Edgell Eastwood. Referring to the scheme for the division of profits, it was with extreme regret to him that it fell to his lot to propose the distribution of a smaller sum than had lately been customary—in fact, by omitting the bonus, to reduce the distribution to what it was exactly eight years ago. A bonus was, as had been repeatedly pointed out from that chair, an extraordinary or exceptional dividend. But the policy of being well prepared for emergencies was in accordance with the best traditions of the Association; and if they considered the contingencies ahead of them, he was sure they would agree with the Board that this 1 per cent. on the capital now more properly belonged to the contingency fund than to the balance available for dividend.

Mr. J. Horsley Palmer seconded the motion.

Mr. J. J. Runtz inquired whether the amount obtained from the sale of residual products was less or more than in the previous half year.

The Chairman replied that the amount was greater.

The resolution was then put and carried unanimously.

The Chairman then proposed a dividend of 5 per cent. for the half year ended Dec. 31 last on the £3,800,000 stock of the Association, payable, free of income-tax, on and after the 11th inst.

Mr. F. Bassett seconded the motion, which was carried unanimously.

Resolutions were afterwards passed re-electing the retiring Directors and Auditor.

On the motion of Mr. Drew, seconded by Mr. R. Fox (who cordially approved the policy of the Directors in not paying a bonus on that occasion), a vote of thanks was passed to the Chairman and the Directors.

The Chairman, acknowledging the vote, said that his services should be rendered to them as long as they could be of use, though he felt there had been signs of weakness that day which he could not overlook. He was sure, however, that he had around him men who would do all in their power to promote the best interests of the proprietors. What had been said with respect to themselves was due in a larger measure, he thought, to the staff—particularly to the staff in Vienna, and especially to Mr. Lindon. He proposed a vote of thanks to the staff at home and abroad.

The motion was carried unanimously; and the proceedings ended.

GEORGETOWN (BRITISH GUIANA) GAS COMPANY, LIMITED.

The Half-Yearly Meeting of this Company was held last Tuesday, at the London Offices, 30, Gracechurch Street, E.C.—Mr. Charles Gandon in the chair.

The Secretary (Mr. Samuel Wood, F.C.A.) having read the notice calling the meeting, the report and accounts were submitted.

The Chairman said he was sorry the report and accounts did not show more favourable results than they did; but he was afraid the causes for this were beyond the control of the Directors. The depression and declining position of the staple production of the colony—sugar—to which he referred at the last meeting, still continued; and there seemed to be no immediate prospect of improvement in it. While this lasted, everything must be more or less in a disorganized state out there. Hopes were at one time entertained that gold, which had been found in workable quantities in the interior of the colony, would have done something towards compensating for the decline of the other product. But so far it did not seem to have been the case; and he did not know that there was anything to be hoped for at the present in this respect. Then, again, the Company had entered into active competition with other means of lighting, more especially with the electric light and mineral oil. The competition with these was so keen that it must necessarily be disadvantageous to all concerned in it—particularly in such a place as Georgetown, where there was scarcely room for three such industries. With regard to the accounts, they did not show any marked improvement. At all events, there was some satisfaction in that there was no retrograde movement indicated by them—in some points, there was a slight improvement. There was a small increase in the gas and meter rental; but against this, coal had cost something more, and the residuals coke and tar had produced rather less. Therefore in these three items, there was little either gained or lost. Some of the items of expenditure showed small economies—notably in the repair and maintenance of works, and in salaries. The main result of the working for the half year was that the balance of profit in the revenue account was £196, as compared with about £128 for the previous half year. The balance of profit, together with the amount brought forward from the last account, was sufficient to pay the interest upon the debenture bonds and the preference shares, and then leave a small balance; but he was sorry to say it was not enough to enable the Directors to propose a dividend upon the ordinary shares. With regard to their prospects, he was afraid to speak much, in case anything he might say should prove incorrect in the future. In addition to certain small economies which the Directors hoped would be effected, since the commencement of the year they had resumed the lighting of 114 public lamps, which would, of course, bring them in a little revenue. Then the prepayment meter system was also making steady but slow progress. At the end of December last, they had 112 prepayment consumers, yielding a revenue of £247 in the half year; while in the six months ending June last, they had 87 such consumers, yielding a revenue of £154. But for these, he was afraid they would not see even such results as they had. Then their Manager (Mr. D. F. Drayton) had been making a careful examination of the street mains, which had given considerable anxiety in consequence of the large leakage. Mr. Drayton had made some improvement; and they hoped still more would be accomplished. Besides these things, from the end of the present year, the allowance paid to their late Manager (Mr. T. B. Younger) would cease, and would, of course, relieve the expenditure of a certain amount. Taking these various points into consideration, they might at least hope that they had come to the bottom of their troubles, and look forward to better prospects. Their local Director (Mr. G. Russell Garnett) was now in England; and he had given the Directors very valuable advice, as his experience and knowledge of the town enabled him to do. The Chairman concluded by moving the adoption of the report and accounts.

Mr. Robert Berridge seconded the motion.

The Chairman, replying to a question, said they would save £360 per annum by Mr. Younger's retiring allowance ceasing at the end of the year. Though they might congratulate themselves upon this in one respect, the Directors were exceedingly sorry that the circumstances of the Company were such as to make it necessary to dispense with Mr. Younger's services. Still they now had the benefit of his advice in this country.

Other questions having been asked regarding the accounts, the motion was put, and unanimously carried.

On the proposition of the Chairman, seconded by Captain H. Thurburn, a dividend was declared on the preference share capital at the rate of 8 per cent. per annum, less income-tax, except upon the dividends payable to shareholders in Georgetown.

The retiring Directors (Messrs. Alfred Lass and H. W. Andrews) and the Auditor (Mr. Magnus Ohren) were re-elected.

A vote of thanks to the Chairman and Directors and to the officials at home and abroad concluded the proceedings.

SINGAPORE GAS COMPANY, LIMITED.

The Annual Meeting of this Company was held last Thursday, at the Cannon Street Hotel, E.C.—Mr. Samuel Spencer in the chair.

The Secretary (Mr. R. M. Christie) read the notice calling the meeting; and the report and accounts, to which reference was made in the "Journal" last week, were then presented.

The Chairman, in moving their adoption, said that the accounts now presented included the working for the past year; and, although not so good in their results as the Directors were hoping they would turn out, they showed a slightly better return than those for the previous year. Had it not been for the unusual expenses caused by the change of management and the increased expenditure for repairs and renewals, a larger dividend could have been paid. The Board were quite sure, however, that the Manager (Mr. Albert Ford) was pursuing the right course; and that the Company would reap the benefit of this policy in due time. The value of the dollar during the past year had averaged 2s. 2¼d.—nearly ½d. more than in the previous year. This, he thought, was highly satisfactory, as it was the first increase over a year that had occurred since he became Chairman of the Company. He thought he ought to mention that the Company had had a loss of about £100 through the theft of a quantity of tar which took place during the Manager's illness. The man who was responsible was instantly dismissed; and Mr. Ford was endeavouring to recover the amount from his guarantors. The Directors, however, considered it better to write the sum off; and they have therefore done so. He was sorry to say that there had been a fire in their coal-store, by which damage was done to the amount of about £180. The Company were fully insured; but as the claim had to be referred to England, the amount had not been included as an asset. He was pleased, however, to say that the full amount had now been paid; and it would be dealt with in the accounts for the current year. The new contract with the Municipality was satisfactorily arranged last year by Mr. Ford; and it came into force on Jan. 1. The Directors were quite sanguine that the present year's working would be much more advantageous to the Company than had been the case during the last three or four years. Mr. Ford was now sending home very good returns for gas, coke, and tar; and besides this, it was anticipated that the new settings of retorts now in course of erection would enable him to increase his make sufficiently to pay the cost of the settings in the course of the next two years. The materials for this work arrived in good condition; and an expert man to build the furnaces had also gone to Singapore; so that in the course of two or three months the Directors hoped to have the benefit of the new settings. The whole cost of the materials was defrayed upon shipment; and by the time of the next meeting of the Company, it was hoped that the results of the new settings would have more than equalled Mr. Ford's expectations. The coals used during the year had been sent from England; and the quantity was 4197 tons. The Directors were just now troubled about sending any more coal from England, as the freight quoted was nearly 30 per cent. in excess of that paid last year; and although they had a favourable coal contract running, they thought of sending the next shipment from Australia, as the cost into store would be quite 4s. or 5s. per ton less than if sent from England. Turning to the accounts, it would be noticed that the receipts for the year amounted to £25,510, or only some £55 more than in 1895. The gas made in the year was 38,956,900 cubic feet—a quantity slightly in excess of the previous year. The private rental improved to the extent of £391; and public lighting, by £31. This small increase would have been larger had it not been for the use of incandescent lighting in a portion of the town. The receipts for coke showed an increase of £218; but he was sorry to say that these advances were wiped out by the decreased profit on tar sales. On the debit side, it would be noticed that coals cost £540 less. The trade and general charges amounted to £400 more; and the repairs and renewals had increased by nearly £300. The latter increase was caused by the mains and services having been well looked after; and this Mr. Ford had made up his mind to continue doing, so as to get them into the

best possible order. The Directors heartily supported such action, as they felt sure that the results would over and over again repay the cost, as the leakage would be considerably reduced. The increase in the item of travelling expenses arose from Mr. Ford going out and Mr. Smith returning home. This having been charged against the year's revenue, left them with a clean sheet for the current twelve months. The prospects were now so improved, that the Board had every confidence that the present year's working would turn out more satisfactory than that of the past three or four years. The balance of £1439 brought down enabled the Board to recommend a dividend at the rate of 1½ per cent., free of income-tax, for the year.

Mr. W. T. Batten, in seconding the motion, said that the Board did not a few months ago anticipate being able to pay any dividend at all; and he thought it would be as well to explain that the whole of the 1½ per cent. per annum which they now proposed to pay had been earned during the last six months of the past year. He might point out that the dividend proposed had not been affected at all by the increased rate for the public lamps which the Municipality had agreed to pay the Company from the commencement of the present year. It was no use being too sanguine about the value of silver; but, with ordinary luck, the increased price to be paid by the Municipality would be a very great help to the Company. Besides this, they would have the benefit, during the last half of the current year, of the regenerator furnaces now being put down. Under these circumstances, he thought the shareholders had great reason to congratulate themselves on the improved position of the Company.

The Chairman, in answer to questions, said that the amount mentioned in the accounts for stocks was fully represented in value. A discount of 10 per cent. was allowed to private consumers; and though this seemed high, it greatly reduced the cost of collection and the losses arising from bad debts. The cost of the new furnaces would be spread over two years, as Mr. Ford was of opinion that the saving effected in that time would cover the whole outlay. These new settings would meet the requirements of the Company for the next five years.

Mr. Robbins strongly urged the advisability of increasing the price of gas to private consumers.

Mr. Batten said that it would be a most disastrous step to raise the price of gas to private consumers. The reason that they had not before this increased the rate for the public lamps, was because they had a contract running with the Municipality; and they had to wait till this expired before moving in the matter.

The motion was unanimously carried.

On the motion of the Chairman, seconded by Mr. R. P. Keys, the retiring Director (Mr. R. G. Rice) was re-elected; and the Auditors (Messrs. Magnus Ohren and T. Guyatt) were also re-appointed.

Votes of thanks to the Chairman and Directors, and to Mr. Ford, the Secretary, and the staff, terminated the proceedings.

MOSSLEY CORPORATION GAS SUPPLY.

Important Extensions at the Gas-Works.

Last Saturday, at the invitation of Mr. R. Merrell, the Engineer and Manager of the Mossley Corporation Gas-Works, a party of about thirty of the leading gas managers of Lancashire paid a visit to the works, with the view of inspecting the important extensions and alterations that have been carried out. Among those present was Mr. W. Newbigging, of Messrs. T. Newbigging and Son, the Consulting Gas Engineers to the Corporation. Mr. Alderman J. Buckley welcomed the party on behalf of the Gas Committee.

On arriving at the works, an inspection was made of the new plant which has been put down; and general approval was expressed with regard to the arrangements adopted. The extensions, which are now practically completed, have been in progress for some twelve months; and the total cost has been about £10,000. One portion of the work has been the addition of a lift to a 100-feet gasholder, making three lifts altogether. The old cast-iron girders have been taken down, and replaced by steel ones with wind-ties. Perhaps the most important change that has been made is with regard to the retort-benches; eight through settings of six ⏀ retorts having been taken down and replaced by four regenerative settings of the improved Klönne type, eight retorts in each bed, or 64 mouthpieces in all—the furnaces being on one side only. The mouthpieces will each produce, on an average, 8000 to 9000 cubic feet of gas per day of 24 hours. The Corporation have now, by the new arrangement, 10 cwt. of coke for sale per ton of coal carbonized, whereas previously they used to have barely 8 cwt.; making a gain of 2 cwt. of coke per ton, while higher heats and a better make of gas are also secured. The gas production during 1896 was 94,842,000 cubic feet, as compared with 85,512,000 cubic feet in the previous year; representing an increase at the rate of 11 per cent. A new coke elevator and conveyor has also been put up. In the elevating arrangement, cast-iron troughs are laid in front of the settings, level with the floor, and as the coke is drawn out of the retorts it is passed into a cross conveyor, and slaked on its way by jets of water. This cross conveyor carries the coke to the elevator, which lifts it some 30 feet above the level of the yard, into a shaking-screen, where the breeze is separated, and the coke sent forward either into hoppers or into a store which extends the whole length of the yard; and it can be delivered at any 7 feet during the whole distance. The coke is not touched after being drawn from the retorts; and the whole arrangement is so automatic that manual labour is for the most part dispensed with. There are two 10-ton hoppers, and one 5-ton hopper; while an apparatus is also provided for disposing of small quantities of coal, such as half hundredweights. Another alteration which has proved advantageous has been the removal of the tower scrubbers from their original position in the yard to one nearer the entrance gates, which gives more space for the stacking of coke.

Among the features which attracted special attention was the system of charging the retorts. In this operation, which the party had an opportunity of witnessing, the long scoop has been substituted for the shovel, whereby the work is done more quickly and effectively. Another point of interest was the method of removing the tar from the hydraulic main. It is taken off at the bottom of the main into a 6-inch pipe, and conveyed to a stand-pipe, at the top of which is a dip-regulating valve, which regulates the seal throughout. The foreman in charge runs the tar out of the stand-pipe every twelve hours. By this arrangement the hydraulic main is entirely cleared of tar. Reference was made, in the course of the inspection, to the remarkable coolness of the atmosphere in the cellars; there being very little radiation of heat. The reason for this lies partly in the fact that ample space is afforded; but the coolness is chiefly due to the action of ventilating flues running along the floor of the retort-house and up the inside walls—taking away any excess heat.

In the extensions that have been carried out, Messrs. Newton, Chambers, and Co. have supplied the holder, retort-fittings, foul mains, steel girders, &c., and also the coke elevator; Messrs. North and Vale, of Stourbridge, have erected the retort-stack and settings; the work in connection with the foundations and retaining walls, floors, &c., has been carried out by the Corporation, under Mr. Merrell's superintendence; Messrs. Westwood and Wrights were entrusted with the re-arrangement and removal of the tower scrubbers.

In connection with the gas-works, there are 36½ miles of mains; the district served including Mossley, Greenfield, Uppermill, Dob Cross, Delph, and Diggle, with a population of about 35,000. The gas is supplied at 3s. per 1000 cubic feet in Mossley, and 3s. 2d. in the outer districts. During the time the new plant has been at work, the results obtained have been in every way satisfactory; and the arrangements generally reflect the greatest credit on all concerned.

After the inspection, tea was provided; and the evening was spent in a social manner—a vote of thanks being heartily accorded to Mr. Merrell and the Gas Committee for their kindness in allowing the party to visit the works, and inspect the admirable new arrangements that had been adopted therein.

STREET LIGHTING AND GAS AND METER TESTING IN LIVERPOOL.

Report by Mr. C. R. Bellamy.

We have received from Mr. C. R. Bellamy, the Superintendent of Street Lighting, Gas Examiner, and Inspector of Meters to the Corporation of Liverpool, a copy of his first annual report on the public lighting and gas supply of the enlarged city. The total number of ordinary gas-lamps in use on Dec. 31, 1896, was 12,858; of special and high-power lamps (8 to 450 candle power, rated at from 2 to 88 cubic feet per hour), 1027; of incandescent gas-lamps, each burner rated at 3 cubic feet per hour, and yielding an average light of 40 candles, 294; of electric 10-ampère arc lamps, 36—making a total of 14,215. The number of lamplighters (including foremen) and mechanics employed at the above-named date was 174. During the past year, 36 electric lamps were fixed in lieu of gas-lamps; and 118 of the latter were put up in 3½ miles of newly-lighted roads. In connection with the scheme for the improved lighting of the city inaugurated in January last year, provision was made for improvements under the following heads: (1) Hours of street lighting. (2) Re-arrangement of lamps in streets in the old municipal boundary, where the lamps exceeded an average distance of 50 yards apart. (3) Lighting of passages. (4) Improved lighting of main thoroughfares in the old city. (5) Lighting of added areas. These have involved the following changes and additions: With very few exceptions, prior to December, 1895, the street-lamps were reduced in power at midnight; the work beginning at 11.30 and being completed by 12.30. The time of commencing was found to be too early; and it was therefore deferred to midnight, being completed by 1 a.m. Some 26 miles of streets have been revised, involving the erection of 222 new lamps, 282 substitutions, and 360 removals; 313 new lamps have been erected in 308 passages, estimated to light the back entrances to about 5000 premises; and 11½ miles of streets have been provided with 317 special lamps, each fitted with two incandescent gas-burners—the gas consumption per lamp being increased from an average of 3 feet to 4½ feet, with an increase of candle power to midnight of from 16 to 80. The lighting of the added areas has been duly organized, and the annual hours extended from a minimum of 2548 to 3350, as against 3808 in the old city. The maintenance of the lamps, &c., has been entirely carried out by the Gas and Lighting Department of the Corporation. The supervision and the clerical work have been done by a staff of twelve assistants. The total charges connected with the public lighting of the city and the supervision of the gas supply for the past year amounted to £43,623.

With regard to gas-meter testing, the total number of meters tested during the year was 6741, made up as follows: Gas Company's meters certified, 4755; do. rejected, 127; sundry meters certified, 1481; do. rejected, 378. The total testing fees amounted to £280 3s. 6d. In connection with this department, by resolution of the Special Lighting Committee passed Oct. 7, 1895, governor gas-burners are received for testing purposes, and stamped when found to be accurate. During the year 16,119 governors fitted with burners suitable for Liverpool gas were submitted for examination, of which 12,464 were stamped and 3655 rejected; the fees received amounting to £11 3s. 11d.

The illuminating power of the gas is fixed by statute at 20 candles when measured with a batswing burner; the one in use being known as the No. 7 steatite batswing, approved by the Metropolitan Gas Referees. The gas is tested daily at the office; and, by agreement with the Gas Company, the Gas Examiner is empowered to test the gas by means of a portable photometer in any part of the city at any time without notice. Under this arrangement, the apparatus is conveyed by cab to any one of the numerous establishments of the Corporation, scattered all over the city, and the gas duly examined. Liverpool gas may, therefore, Mr. Bellamy says, be said to be the most severely tested for illuminating power in the kingdom. The results of the tests are as follows: Average of 296 tests at the office, 20·89 candles; do. of 91 tests on the district, 20·84 candles. There were 379 tests, involving 606 visits to the various works, made for impurities; and 81 tests were carried out at the office. They all showed that the gas fulfilled the statutory requirements in regard to purity.

For testing the pressure, there are seven stations, in various parts of the city, fitted with automatic recording pressure-gauges. To these stations 946 visits were paid last year; and the results afforded satisfactory evidence of equal distribution.

LEEDS CORPORATION GAS AND WATER SUPPLY.

The Gas and Water Profits and the Rates.

At the Meeting of the Leeds City Council last Wednesday—the MAYOR (Sir J. Kitson, Bart., M.P.) in the chair—the question of laying the rates for the year ending March 25, 1898, gave rise to some remarks on the appropriation of the gas and water profits.

Alderman GORDON (the Chairman of the Finance Committee) submitted the estimates of expenditure, and proposed the laying of a city rate of 2s. 2d. in the pound. Dealing with the effect of last year's financing, he stated that the Committee began with a deficiency, which they inherited from their predecessors, of £49,636. The city rate deficit on March 25, 1896, was £20,016; on March 25, 1897, it was £6620—a reduction of £13,396. The deficiency on the consolidated rate in March, 1896, was £16,573; in March, 1897, £14,900—a decrease of £1673. On the highway rate account the year began with a deficit of £379; which was reduced to £286—a decrease of £92. It would be seen, therefore, that the rating accounts were better at the end of the year than at the beginning by £15,162. Last year the Finance Committee received a grant of £18,000 from the Gas Committee. It had been represented that this was a contribution to the rates; but the real effect was that about £3000 went to the rates and about £15,000 towards wiping off the deficit with which the Finance Committee were saddled in March, 1896. The general effect was that whereas the Committee began the year with a deficiency of £49,636, the year ended with one of only £38,846. The Committee therefore thought they were entitled to look with some satisfaction upon these figures, because by the operation which they persuaded the Council to employ last year they had not only kept the rates steady, but decreased the deficiency to the extent of £11,000. The Committee hoped that in the future they would be able to pursue both these policies. It was proposed to ask the Water Committee to grant them £18,000 out of their surplus, the effect of which, roughly, would be that about £9000 would go towards the rates and £9000 towards paying off the deficiency. If this were done, at the end of the year the deficiency would have been reduced from £49,636, at which figure it stood a little more than a year ago, to £30,000. He did not intend to go into the question as to why it was proper for the Water Committee to make the grant proposed, as it would have to come before the Council by a special resolution at the next meeting, if the Committee agreed to make a grant, as he believed they would.

Mr. HENRY criticized the proposal. He said Alderman Gordon had taken credit for keeping the rates steady; but he (Mr. Henry) saw nothing brilliant in that. Neither did he think there was anything wonderful in having reduced the floating debt last year by £11,000, seeing that they had £20,000 extra funds to do it with—viz., £18,000 from the gas profits and £2000 from the School Board. Now the same policy was proposed to be pursued—the rates were to be kept at the same level, and a further reduction was to be made in the debt by taking the profits from the water-works. He contended that, instead of pursuing this course, the proper way was to levy upon the ratepayer the amount that was expended upon him.

Mr. BOWLING contended that they ought to have met the additional expenditure by increasing the rates; and he opposed the proposals of Alderman Gordon, because they were marked by all the evil characteristics of Tory finance. Last year they took £18,000 from the profits of the gas-works; but inferior management was beginning to tell there, and profits now were at about the vanishing-point. The water-works, however, were as prosperous as ever. The rain had fallen as plentifully upon "the evil" as it fell upon "the good;" and there was a magnificent surplus of £30,000, upon £18,000 of which Alderman Gordon proposed to lay hands. He contended that now, when trade was so prosperous, the rates should be made to meet the expenditure, and that surpluses should be kept to fall back upon in bad times.

Mr. C. H. WILSON defended the proposal. He said the Acts of Parliament under which the water-works, the gas-works, and the tramways were carried on expressly stipulated that, after the formation of a reserve fund, all profits "shall be" paid into the City Fund. In the case of the gas-works and the water-works, this he knew had not been followed out; but he should not rest until the statutory provisions were strictly adhered to. Why should these profits not be applied to reducing the rates? To whom did the gas and water works belong? To the ratepayers; and it was they who ought to benefit by any profits accruing.

Alderman A. COOKE, as Chairman of the Water Committee, said he should place the resolution of the Finance Committee before the members of his Committee; and it would receive the consideration to which it was entitled.

Mr. FORD urged that, seeing the reserve fund of the Water Committee amounted to only £30,000, it was impolitic to appropriate any of the profits for the relief of rates.

Alderman HARLAND said that in applying money in relief of the rates from either the gas or the water profits, they were not adopting any new course. Some years ago, they had a surplus fund provided by the water-works of no less than £80,000. The then Town Clerk called the attention of the Council to the matter, and said "this must go to the relief of the rates;" and it was so applied.

Alderman Sir E. GAUNT contended that a reserve fund of £30,000 on the water-works was too small; and to take £18,000 of the profits to keep down the rates was a dishonest way of meeting liabilities.

Mr. LOWDEN (the Chairman of the Gas Committee) said if certain members of the Council considered it so desirable that profits from gas or water should not go in relief of the rates, the only alternative was to advance the rates. Were they prepared to do this? If so, let them propose an amendment to this effect. The fact was that, while their Radical friends had the audacity to criticize, they had not the courage to suggest an alternative. In the course of his speech, Mr. Bowling referred to what he called the "vanishing profits" of the gas department. The profits of his Committee had by no means reached the vanishing-point. They had wiped off the debt of £33,000 left them by their Radical predecessors; had reduced the price of gas by £20,000 last year; and in the course of a few weeks more Mr. Bowling would find that they would have a very substantial sum to the good.

Alderman GORDON, replying on the discussion, twitted the Radical party with having for half-a-century been in the habit of appropriating balances from various funds, and then coming there to protest against the principle. He said that between 1877 and 1887, the water-works profits amounted to £60,000; and what did they do with this sum? They paid it into the borough fund, and it went in the reduction of rates.

Alderman Sir E. GAUNT: According to law.

Alderman GORDON: Well, what we are doing is not in defiance of law. The law says we "may" pay such surplus into the borough fund in reduction of the rates.

The TOWN CLERK: "Shall pay into the borough fund."

Alderman GORDON: The Town Clerk reminds me that it is "shall," after certain conditions have been observed. No matter what party was in power, he believed in trying to keep the rates steady. "Jumping Jack" arrangements were good for nobody. If the Radical argument meant anything, it was that the rates should be advanced. Yet they dare not propose it, because the ratepayers had been shown that their expenditure could be met without resorting to any such plan.

The resolution was adopted by a large majority.

It was then resolved, without discussion, to levy a consolidated rate of 2s. 11d. in the pound.

ROTHERHAM CORPORATION GAS SUPPLY.

Satisfactory Condition of the Gas Department.

At the Meeting of the Rotherham Town Council last Wednesday—the MAYOR (Alderman G. Neill, J.P.) in the chair—the report of the Gas Committee on the working of the undertaking in the twelve months ending March 25 was submitted.

Mr. G. GUMMER, in moving the adoption of the report, referred to the very satisfactory condition of the Gas Department. He said the gross profits during the past financial year had reached the sum of £10,530, against £9201 in the previous year; being an increase of £1329, and equal to a little more than 10 per cent. on the capital invested in the works. Considering the very small profits made in the past four or five years, they might assume they had reached a period when they might look for further improvement. The profits made had been absorbed as follows: Dividends on stock, £4136; sinking fund, £929; extra premiums returned, £356 — leaving a net profit of £5109. But from this sum there was deducted the cost of public lighting, £1365; giving a net available profit for relief of the rates of £3744. It might be asked how this profit had been brought about. He was pleased to state that the present Manager (Mr. Murdock) had produced more out of a ton of coal than had ever been done by any previous Manager of the works. The make of gas had been 11,056 cubic feet per ton of coal carbonized, against 10,466 cubic feet last year. The Manager, it was only fair to say, had had the advantage of an extra supply of cannel coal. The profit had also been due to an augmented consumption of gas; and that would for a considerable period be still further developed. The increased consumption last year was 25,765,700 cubic feet, of which 10,732,350 feet was for automatic meters alone. This showed that the policy carried out of putting in automatic meters wherever they were required was a sound one, and ought to be still further extended by granting concessions to consumers. The number of automatic meters fitted up during the year was 2083, against 1415 in the previous year. The increase was still going on, as they had a great number of demands for these meters. The total number of automatic meters in houses was now 3498, or nearly half the total consumers, who numbered 7543. They were approaching a time when the consumers on the books would very nearly equal the householders. There had naturally been a little increase in leakage; but this was still low—being 7·77 per cent., which was below the average given in Field's "Analysis." In a town like Rotherham, subjected to subsidences of land, and with a great length of mains, he considered this was satisfactory. With regard to residuals, these came out very well. Prices had been better, with the exception of ammoniacal liquor. Coke had produced £4250, against £3623; tar, £1613, against £1317; and liquor, £694, against £934. Replying to certain criticisms that the profits were attributable to the diminished price of coal, he said that, as a fact, coal had cost £8107, or 8s. 10¼d. per ton, as compared with £7218, or 8s. 8¼d. per ton in 1895-6. They had had to pay £1297 more for labour; but they had effected a saving of £700 in public lighting, without any real grievance to the ratepayers. He understood that the Mayor and the Chairman of the Finance Committee were going to make a suggestion that another £1000 of the net profits should be handed over in relief of the rates. It had been proposed that the profits should be appropriated as follows: Reduction of rates, £1325; deficiency on market account, £419; contingent fund, £2000. While he thoroughly agreed with the latter proposal, he was of opinion that the consumers of gas should have some consideration, and that the time had come when the Committee should decide whether the price of gas could not be reduced. He knew he should be told that it was simply taking money out of one pocket to put it into the other; but it was no such thing. He contended that the gas profits should not be altogether used for the relief of landlords and property-owners in the shape of reduced rates; and he failed to see that the Gas Department should be used as a means of indirect taxation. Further, he reminded the Council that they had to pay income-tax on the profits of the department, which would be avoided by reducing the price of gas. He favoured a reduction to 2s. 6d., 2s. 4d., and 2s. 1d., as compared with the present charges of 2s. 9d., 2s. 6d., and 2s. 3d. per 1000 cubic feet. He had mentioned this matter because he knew the Mayor was going to move that, out of the £2000 proposed to be set apart for the contingent fund, £1000 should go towards the district rate, to keep the latter down to 2s. 2d. in the pound. They had no right to depend on the gas consumers to keep down the rates. He believed if the price of gas were reduced, there would be increased consumption; and he asserted that, unless the price were lowered, the owners of certain works in the town would take steps to adopt the electric light. He thanked the officials and workmen for the assistance they had rendered in bringing about the results he had laid before the Council. He also explained, with reference to the dispute which arose last November, that the Arbitrator (Mr. C. E. Rhodes) was waiting for certain information

he desired to obtain from the Manager, on the receipt of which he would be able to give his decision.

The Mayor said he certainly thought Mr. Gummer should be inclined to vote as much as possible for the relief of the rates. But he had spoken as if the gas-works belonged to the consumers instead of to the ratepayers, who would have to bear any loss that might occur. He saw no reason why the profits should not be larger next year.

Mr. Stoddart seconded the motion. He said the gas-works capital in the books was £116,000, and the gross profit was £10,530, or 10 per cent. But if the accounts were treated in the same way as those of a public company, there would be a large sum written off for depreciation.

Mr. Gummer remarked that this had been done.

Mr. Stoddart said he would give Mr. Gummer credit for what had been done during the past year. The gas-works were not earning an extortionate profit for the ratepayers.

Mr. Copley reminded the Council of the plea urged a month ago of the necessity of at once commencing the extension of the works. He inquired what had been done.

Mr. F. Mason replied that Mr. Newton, the Consulting Engineer, had been down, taken his measurements, and prepared plans which would be submitted to the Sub-Committee.

Mr. Pearce proposed that the clause in the Committee's report which recommended the appointment of a Sub-Committee to consider Mr. Newton's plans be struck out.

Mr. Sorsby seconded this amendment, and there was some conversation as to whether or not it was in order.

On being put to the vote, the amendment was lost; and the motion was agreed to.

STOCKTON CORPORATION GAS SUPPLY.

Growing Business—The Gas Committee and the Workmen.

At the Quarterly Meeting of the Stockton Town Council last Tuesday, the annual report of the Gas Engineer and Manager (Mr. William Ford) was presented. It recorded that the make of gas during the past year had been 325,818,000 cubic feet, or an increase of 13,343,000 cubic feet compared with 1895-6. The net addition to cooking-stoves was 101; making the large total of 3000 on hire. The net increase of meters fixed was 412, which was gratifying evidence of the increasing popularity of the uses of gas as a lighting, heating, and motive power agent throughout the area of supply. The Gas Committee stated in their minutes that they had requested the Manager to report to the next meeting as to the advisability of extending the prepayment meter system. Also that they had received a letter from Mr. J. Merryweather, the Secretary of the Trades Council, requesting them to receive a deputation from the Council with Mr. Lynas, of the Gas Workers' Union; but they had deferred its further consideration to a future meeting.

Alderman Richardson, in moving the adoption of the minutes, congratulated the Council upon the increase in the consumption of gas, which amounted to at least 5 per cent. more than the make of the previous year, and that notwithstanding one or two large works had adopted the electric light. The increase had been largely due to the extension of cooking by gas. The eight-hour system had contributed to an increased cost in the make of gas; but he did not regret this, as he thought it was a very desirable innovation in view of the arduous nature of the stokers' work.

Mr. Vickerson moved, as an amendment, that the Gas Committee receive a deputation at once in regard to the subject of the gas workers' employment. It seemed strange that the matter should be of such vital importance that it should have to be adjourned; and he could see no reason why the Committee should not receive the deputation at once.

Mr. J. Smith seconded the amendment, because he thought the Committee were playing at hide and seek with the question. The Chairman was the only member of the Committee who was not afraid to meet the men.

Mr. Green supported the amendment, and said the Committee in their attitude on the question were emulating Lord Penrhyn. [Alderman Richardson: No, no.] That was the principle involved here. An injustice was being perpetrated by the Corporation greater than that perpetrated by Lord Penrhyn.

Mr. A. Smith also supported the amendment, and said almost all the corporation gas-works in the country recognized the agency of the Gas Workers' Union, and received deputations.

Mr. Cameron held that, if the men had a grievance, it was their duty to approach the Manager in the first instance; and then, if the Manager declined to listen, the men were justified in making an application to the Committee.

Alderman Richardson remarked that the Committee desired to act fairly, even handsomely by the men; and if Mr. Vickerson would withdraw his amendment, as far as he was concerned, he might say that he would have no cause to regret it.

The amendment was withdrawn.

Mr. Vickerson drew attention to the fact that the eight-hour system had only resulted in an increased cost of £530, though members at the time it was under discussion said it would mean an additional rate of 3d. to the town. This he considered very satisfactory.

The minutes were then adopted.

STOCKPORT CORPORATION GAS SUPPLY.

Alarm as to Water Gas—Local Government Board Inquiry.

Last Tuesday, Mr. G. W. Willocks, M.Inst.C.E., one of the Inspectors of the Local Government Board, resumed his inquiry into an application made by the Stockport Corporation for power to raise money for various purposes; £36,039 being required for the extension of plant in connection with the gas-works. When the matter was reached, the Inspector asked if the prospective loan had anything to do with water gas. The Town Clerk (Mr. W. Hyde) replied that it had not. It was wanted for the supply of coal gas; but he could not give any assurance that water gas would not be used. In any case, the mains were wanted. The Gas Engineer (Mr. S. Meunier) gave a detailed statement of the various amounts required; £10,500 being for meters, £10,000 for purifiers, £750 for stoves, and £6000 for mains and services—the rest being for extensions of mains, paving, &c. Mr. Meunier explained that the proposed expenditure for the relaying of pipes was necessitated by the enormous extension of gas consumption in the outlying districts, and not because the pipes had been found defective. Several questions were put to Mr. Meunier by Mr. G. Burrows and Mr. J. Brown (the Secretary of the Power Loom Weavers' Association). Asked if water gas would be permitted to go through the pipes, he replied to the effect that any gas that happened to be made—whether it was water gas, oil gas, or coal gas—was bound to go through. They were making water gas now, and using it with coal gas, but never in a greater proportion than 25 per cent.—indeed, he did not think they had ever reached that yet. They generally varied between 6 and 19 per cent. The mains would be used to convey the mixture. Mr. Burrows said he supposed he was to understand that they had continued making water gas, though the Local Government Board had refused to sanction a loan for the erection of plant for the manufacture of it. Mr. Meunier replied that that was so. Mr. Burrows, after reading an extract from the letter received by the Town Clerk from the Local Government Board on this subject, said that, in spite of the warning contained therein, they had gone on making it. Mr. Meunier said certainly. Mr. Burrows asked what were the regulations or conditions under which water gas was being manufactured. Was it not an established fact that the gas contained a highly poisonous matter? Mr. Meunier said there were no regulations or conditions. If any were introduced by Parliament or the Local Government Board, they would, of course, have to be enforced. Mr. Burrows next asked Mr. Meunier if he thought the Gas Committee were justified in making water gas when there were so many people in the borough working twelve hours a day gassing yarns. Mr. Meunier said the only danger to life in the gas as supplied by the Corporation, was prolonged contact with it in a badly ventilated room, without combustion. Mr. Brown suggested that by enlarging the existing pipes they would be enabled to send more water gas through them. Mr. Meunier said they certainly could, if they were so disposed; but they did not intend doing so. Their present water-gas plant was capable of making about 550,000 cubic feet in 24 hours; while the coal-gas plant could produce about 3½ millions in the same time. Mr. Brown asked who would bear the responsibility if anyone should die from the results of breathing water gas, as the Local Government Board had warned them against it. Mr. Meunier was not prepared to say. If there ever was a death from such a cause, the case would undoubtedly be gone into, and action taken by the Corporation if it was found necessary. Mr. Brown asked if it was not a fact that in the yarn-gassing rooms the smell was bad. Mr. Meunier acknowledged that it was; but he said this did not arise from the gas itself, the smell of which was not disagreeable, but from its contact with the yarn. The inquiry then terminated.

SALES OF STOCKS AND SHARES.

At the Mart, Tokenhouse Yard, on Monday last week, Mr. Alfred Richards conducted a large sale of gas and water stocks and shares. A parcel of £10 new shares in the Worthing Gas Company, issued by the Directors as fully-paid, realized from £17 5s. to £18 2s. 6d. each—the bulk fetching £17 10s. These shares carry a 7 per cent. dividend, which will accrue from July 1 next. A lot of £150 of 10 per cent. stock of the Company was sold at the rate of £237 10s. per cent., with dividend as from the commencement of the year. A 4 per cent. £50 perpetual debenture bond of the Chigwell, Loughton, and Woodford Gas Company was purchased for £112; some 10 per cent. stock of the Company, entitled to 12½ per cent. dividend if earned, was disposed of at the rates of £227 10s., £229, and £231 per £100 of stock; and some fully-paid £10 shares, ranking for a 7 per cent. dividend, but entitled to 9½ per cent. if earned, fetched £16 2s. 6d. and £16 5s. each, *cum div.* from Jan. 1 last. Two £10 shares in the Epping Gas Company, Limited (dividend 5 per cent. with 2 per cent. bonus), were knocked down for £18 apiece. Six lots of new stock of the Commercial Gas Company, the last dividend on which was at the rate of 10½ per cent. per annum, were sold - one at the rate of £273, and the rest at £267 per cent. Some fully-paid £5 shares in the Horley District Gas Company, Limited, the last dividend on which was at the rate of 3 per cent. per annum, were knocked down at £4 7s. 6d. and £4 10s. each. Fully-paid original "A" shares in the Harrow and Stanmore Gas Company (last dividend 7½ per cent. per annum) fetched £17 5s. each; some "C" shares (5½ per cent.) realizing £12 7s. 6d. apiece—in all cases with the dividend accruing from Jan. 1 last. Some fully-paid £5 shares in the Clacton-on-Sea Gas and Water Company, Limited, the last dividend on which was at the rate of 4½ per cent. per annum, were sold for £6 and £6 5s. each *cum div.* Fully-paid £50 "C" shares in the Portsea Island Gas Company (last dividend 12 per cent.) realized £145 and £148 each *cum div.* Some original £5 "A" shares in the Cromer Gas Company, Limited (last dividend 7 per cent), were knocked down for £8 12s. 6d. each. Sixty fully-paid original £5 shares in the Godstone District Gas Company, Limited, found purchasers at £3 for forty, and at £2 10s. for the rest—not a bad figure, in view of the fact that the income is only about sufficient to pay the debenture interest.

At the Mart, last Wednesday, Messrs. Fox and Bousfield sold, in accordance with the announcement last week, some original £5 shares in the Chertsey Gas Company at £14 10s. each, new "A" £1 10s. shares at £3 each, new "B" £2 10s. shares at £6 10s. each, and new £10 "C" shares at £23 each.

Among other recent sales, the following may be noted: At Sheffield last Tuesday, Messrs. Bush and Son sold by auction a number of Corporation water annuities and a quantity of stock and shares in the local Gas Company. Eighteen water annuities of £5 each were disposed of at £157 apiece; and eight progressive annuities of £3 each, rising ¼ per cent. biennially to £4 in 1904, were sold at £118 10s. each. Regarding the gas stock and shares, £817 10s. of "A" stock was bought at 249½ per cent.; £669 10s. of "B" stock, at 249¼ per cent.; £600 of "C" stock,

at 248¾ per cent.; and £1505 of the same stock at 248¼ per cent. Fully-paid "D" shares of £6 each, fetched from £14 7s. 6d. to £14 15s. each; and "F" shares, of £3 each, 12s. paid, were bought for £4 2s. 6d. and £4 5s. Some fully-paid £10 ordinary shares in the Leatherhead Gas Company recently realized an average price of £61 each. A few fully-paid £10 (7 per cent.) shares in the Matlock Water-Works Company were sold by auction last week for £14 5s. per share.

ELECTRIC LIGHTING NOTES.

The Hastings Town Council have confirmed the resolution recently passed by them in Committee (see *ante*, p. 951) to purchase the undertaking of the Electric Light Company as a going concern for £58,000.

The St. Helens Corporation Gas and Lighting Committee are proposing to borrow £17,000 on their electric lighting undertaking—£7500 in duplicating the plant, an equal amount for mains, and the sum of £2000 is required to meet excess expenditure on the present works.

At a special meeting of the Rochdale Town Council last Thursday, Mr. Lord moved that application be made to the Local Government Board, in accordance with the recommendation of the Gas Committee, for a Provisional Order to supply electric light in the borough. He said the Committee thought that the time had come when they ought to erect a station of their own. The motion was carried unanimously.

The Cardiff Corporation Electrical Committee are recommending the Council to seek powers to borrow about £30,000 for a large scheme of extension and improvement of the electric lighting works and system. It is proposed to spend £5326 in the extension of the engine and boiler rooms; £13,320 on plant; £6347 on two high-pressure mains, with the necessary sub-mains, &c.; and £2800 in converting the existing system to 200 volts for distribution. The balance is put down for contingencies.

A deputation of the Eccles Town Council has been to Brighton for the purpose of inspecting the system of electric lighting there. They were so charmed with all they saw and heard, that they have not hesitated to advise the Council to adopt a scheme of electric lighting, and to apply to the Local Government Board for permission to borrow £11,408 for the purpose. The Council have accepted this advice; but how many of the members, in giving their vote, thought of the dissimilarity between Brighton and Eccles?

Though the Board of Trade have intimated that the result of the forthcoming Vestry election at Newington will not be ignored by them, the Progressives have discreetly declined to fight on the electric lighting question only; while prominent members of their party have not hesitated to make insinuations against the impartiality of Sir Courtenay Boyle, who represented the Board of Trade at the recent Conference. If, therefore, the Progressives are beaten at the polls, they will maintain that electric lighting was not made a test question; but should they prove victorious, the movement will once more come to the fore, and the Board of Trade will again be petitioned for a Provisional Order.

For long the York City Council have been deliberating upon the course they shall take in regard to an electric lighting scheme; but they have been unable to come to any decision. The question was again publicly discussed on Monday last week, upon a recommendation of the Streets and Buildings Committee that offers from Electrical Contractors to take over the Electric Lighting Order should be declined, and that the Corporation themselves should carry out a scheme. Some of the members considered that, with rates at 7s. in the pound, it would be unwise to embark on a speculative undertaking; and, by 17 votes to 15, they decided to eliminate the paragraph relating to the electric light from the Committee's minutes.

Notwithstanding the resolution come to by the Newmarket District Council to abandon their application for electric lighting powers, the town may yet be furnished with electric light; for, at the meeting of the Council on Monday last week, offers were received from two firms to take over the Order, paying all out-of-pocket expenses, and giving the Council the option, in one case, of re-purchasing the undertaking after a certain period. Mr. Ellis said he thought that, though the Council were actuated by the best intentions, they had perhaps been a little too hasty at the previous meeting. The letters they had received made a considerable difference in the aspect of the matter; and to meet this alteration in the position of things, he had a motion to propose which he thought would not clash with the resolution already passed, and would be unanimously adopted by the Council. He moved that, in view of the resolution, the Council should not proceed further as regards an Electric Lighting Order, and that the Clerk be instructed to ask any inquiring Companies what they were prepared to offer for the Order, as it at present stands, and if they were willing to take the same, and indemnify the Council against all expenses and liabilities already or likely to be incurred. Mr. Carr seconded the proposition; and it was unanimously adopted. It was also decided that the Board of Trade should be requested to adjourn their consideration of the Council's application for a week, from the 5th inst.; and as the resolution already passed will prevent the Council putting down an electric light installation, the gentlemen who had opposed the scheme informally stated that, so far as they were concerned, opposition to granting the Order would be withdrawn.

One would imagine from the carefully studied manner in which the Deputy-Mayor of Whitehaven endeavoured to show the Council at a recent meeting that the cost of electricity for public lighting was cheaper than gas that he had had an inkling that contrary views existed. He said it was impossible to compare the electric lighting with anything that had been paid for gas in the past. The cost of lighting had varied from £1900 to £823 in the years the town was lighted by gas; but he did not think it was fair to make a comparison even on averages. The way he compared electric lighting to gas was this: It was, he remarked, an acknowledged fact that 8 units of electricity were equal in illuminating power to 1000 cubic feet of gas. Therefore the price of 1 unit ought to be one-eighth the price of 1000 feet of gas. They charged 4d. per unit, which was equivalent to gas at 2s. 8d. per 1000 feet. The increase from £823 (the price of the public lighting the last year the town was lighted by gas) to £1328, was on account of the enormously increased quantity used. The gas-lamps then were only 406 in number; while they had 440 electric lamps. The number of hours gas was burned was 2200 per annum; but the electric light was "on" for 2800 hours per annum. The relative cost of 2s. 8d. included repairs, maintenance, and renewal of lanterns and posts; whereas under the old system, the Trustees paid a certain price per 1000 cubic feet for the gas—varying from 2s. 10d. to 3s. 3d.—besides an amount for the repair of old lamps, for lighting and extinguishing, and also for painting and maintenance. So that, although the sum appearing in the estimates this year for public lighting was larger than that paid for gas during the last years gas was used, yet the cost of electricity was considerably less, light for light, than it was for gas. Even after this ingenious statement, some of the more inquiring ratepayers will be asking themselves whether the additional 34 lamps and 600 hours' lighting are worth the extra £505 which they are now called upon to pay.

Two resolutions dealing with a proposal to municipalize the electric light supply of Birmingham were upon the *agenda* for the meeting of the City Council last Tuesday. The first, which stood in the name of Mr. T. Fletcher, was as follows: "That it be an instruction to the General Purposes Committee to consider and report as to the desirability or otherwise of the Council purchasing the undertaking of the Birmingham Electric Supply Company, Limited; also to ascertain and report whether and upon what terms the Company are willing to transfer their undertaking to the Council." The second resolution stood in the name of Mr. Bisseker, and was to the effect that a Special Committee should be appointed to ascertain if, and on what terms, the Electric Supply Company would be willing to sell their undertaking. Mr. Fletcher, in moving his resolution, said he had felt for some time that this was a matter deserving the attention of the Council. There was, he believed, a growing opinion in the city in favour of this step; and the present was an opportune time, because the longer the matter was delayed, the more difficult and expensive it would become. Electric lighting was now past the experimental stage; it had proved to be a great commercial success, and capable of great development. But Birmingham in this respect lagged behind other cities, both in regard to its municipal enterprise and the extent to which the light was used. The business of the Electric Supply Company had not, judged from financial results, been a great success; and he did not think the electric light would ever be very successful in Birmingham until it was under the control of the Council, because the public spirit of many of the citizens made them hesitate about doing anything which would injure the gas undertaking. If both undertakings were under the control of the Corporation, instead of being rivals they would be allies. He dwelt on the steady increase in the demand for Corporation gas, as evidenced by the expenditure of £43,000 on water-gas plant, and the statement by the Chairman of the Gas Committee that it would be necessary to come to the Council at an early date with a still larger scheme for the provision of an adequate reserve supply; and he argued that the acquisition of the electric light undertaking would save this additional expenditure. The capital of the Company was £200,000, which was all called up; and the shares were at a premium. Provided the terms asked were not prohibitive, he believed the acquisition of the undertaking would be found a wise and safe investment, an important public convenience, and eventually a great public success. Alderman Bowkett seconded the motion. The Lord Mayor said he might save the time of the Council by stating that the General Purposes Committee were prepared to adopt Mr. Fletcher's suggestion, and he hoped the Council would refrain from further consideration until they had the whole matter fully before them. He understood Mr. Bisseker was quite willing to withdraw his motion if this suggestion was adopted. Mr. Bisseker said he accepted the suggestion. The motion was then carried unanimously; the members who are shareholders in the undertaking abstaining from voting.

Explosion at the Burnley Gas-Works.—A rather alarming explosion of gas, fortunately unattended by grave consequences to the workmen, occurred in the purifier-house at the Burnley Gas-Works last Wednesday. A purifier was shattered, the roof of the house was blown away, and the woodwork set on fire; but the damage was confined to the building.

Additional Water-Gas Plant for Coventry.—The water-gas plant which was put down at the Coventry Gas Works a few months since has been working so satisfactorily that the Gas Committee have decided to advise the Council to duplicate it. The total daily productive capacity of the plant will then be 1,200,000 cubic feet. The amount which the Committee were authorized to borrow for the erection of water-gas plant was £7000. An additional £3500, making a total of £10,500, will, it is estimated, be sufficient for the duplication of the apparatus. In view of the continued increase of consumption, the Committee have also under consideration a scheme for auxiliary works, which will be submitted to the Council in time for parliamentary powers to be obtained for its execution in the session of 1898.

Southampton Gaslight Company.—The half-yearly meeting of this Company was held last Wednesday, under the presidency of Mr. R. C. Hankinson, J.P. Moving the adoption of the report, the Chairman said the Directors considered it a satisfactory one. The amount available on the half-year's working was £8926; and the maximum dividends would come to £8313, which would leave a balance to be carried forward of £613. The last two or three half years they had been obliged to draw upon the amount carried forward and the reserve fund; but now they were able to return the money and to pay the full dividends. The quantity of gas sold during the six months was 207,138,000 cubic feet, against 190,155,000 feet in the corresponding period of the previous year; the increase being nearly 17 million cubic feet for the half year, and for the whole year 21,595,000 feet. The assessment of the Company within the borough had been raised from £6790 to £7453. The Directors intended to appeal, and he hoped they would be successful. The last time they had to appeal against their rating, it cost the Company and the town above £4000. The Company were large ratepayers. During 1896 they contributed £2853 to the local rates, which represented a payment of rather more than 2½d. per 1000 cubic feet of gas manufactured; and no doubt if it was not for this heavy rating, they would be able to take off 1d. from the present price. The Legislature some years ago compelled the issue of all new gas shares to be sold by auction. They did not at first know how this would work; but it had acted very favourably for the Company, as £38,458 had been realized in premiums on the sale of shares and £10,869 on the sale of debenture stock; so that the shareholders and consumers had practically £50,000 to the credit of capital account, on which they paid no dividends or interest whatever. Dr. Trend seconded the motion, which was agreed to.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The Edinburgh Corporation Bill was approved by the Committee of the House of Lords yesterday. In terms of it, the Edinburgh and Leith Gas Commissioners' agreement with the Town Council of Edinburgh, under which the Commissioners take over from the Council the undertaking which they acquired from the Portobello Gaslight Company, is ratified. Another important provision of the measure is that which empowers the Gas Commissioners to hold someone other than the actual occupier of a house liable for gas consumed in the house. The enactment is intended to meet the case of a person who rents a dwelling for a whole year, and lets it out furnished, for a portion of the period. This is a very common practice in Portobello, which is a seaside resort. The real tenant may be away from the house for six months, during which time it may be occupied by six or more different families. At present, the Gas Commissioners have only power to charge the actual consumer for gas supplied; but as in Portobello these short-time visitors might occasionally leave without paying, the Commissioners would be apt to lose revenue. Power is, therefore, taken to hold the yearly tenant liable. The provision, I have not the slightest doubt, will lead to friction. It will require to be very widely advertised; but even then everybody will not see it. The consequence will be that some householders will let their houses without making a charge for the gas to be consumed; and then, when the gas accounts come in, it is more than can be expected of human nature that they should not at once say that they were not in the house, and therefore consumed no gas. Then the provision of this Bill will come in; and if they do not pay, they may be prosecuted. Whether the Commissioners will have power to prevail in any such claim, I have my doubts. As I have said before, I look upon the whole of the provisions relative to the gas undertaking to be faulty. That the Bill has passed the Referees of both Houses of Parliament, does not remove my objection to it, which is that the Town Council, not being the owners of the gas undertaking, cannot acquire powers for the owners. The Gas Commissioners ought to have been a party to the Bill. I quite admit that the Town Council, who were the sellers of the Portobello gas undertaking, could obtain an Act of Parliament empowering them to hand it over to the Gas Commissioners. But when it is handed over, they cease to have any interest in the concern, or authority over it; and I cannot help thinking that any enactment, such as that relating to the liability of yearly tenants, will be very much of a dead-letter. I do not know of any parallel case to it. The nearest I can think of is where a railway company are empowered to divert a public road, and to substitute it for the old portion of the highway. But in such a case it will generally be found that the company are obliged to pay a sum yearly to the road authority, so that any extra cost of upkeep of the new road does not fall on the authority. In other words, there is a continuing obligation on the part of the railway company, who are thus kept in, and would be liable to sue or be sued. If this sort of Bill be competent, it leaves the way open for legislative jugglery. For instance, a railway company and a shipping company, separate undertakings, might so agree that the railway company—say a Scotch one—when they promoted a Bill for general purposes, might insert a clause empowering the shipping company, trading with London, to levy heavy terminal charges in respect of their station on the Thames. Even this is not a parallel, because opposition would soon bring the shipping company to their senses. But how would a Londoner look, if he should be sued under a Scotch Railway Act, in respect of an article which had never been in the hands of the Scotch railway company at all? I think it is quite evident that the Gas Commissioners are placing themselves in a wrong position; but the point will probably be tested before long, if on no other ground, upon that relating to the yearly tenant's liability for gas consumed by his sub-tenant.

It is announced from Dundee that the gas-rental for the year ending April 30 amounted to £75,692. There is a decrease of £1433 upon the sum collected in the preceding year, which is not attributable to a lessened consumption of gas, but to the fact that the price has been 1d. per 1000 cubic feet less. The electricity rental amounted to £5542—an increase of £660. Both departments are thus in a healthy condition. A Sub-Committee of the Corporation have recommended the purchase of 57,000 tons of coal for the gas-works. The average price is about 2½d. per ton higher than under last year's contracts.

The Glasgow Town Council on Thursday, after twice failing, at last succeeded in appointing an Electric Lighting Committee.

On Monday evening, about seven o'clock, a fire broke out in the retort-house of the Broughty Ferry Gas-Works. Next morning the local newspapers came out with accounts of the affair, which anyone could see were an overdoing of the case. For example, it was said that the outbreak occurred with great suddenness; and then the writer, after harrowing his readers with details as to the density of the smoke, the rush of adjoining residents from their homes, and the carrying out of their dwellings of two invalid women, said that the fire brigade arrived, and "the fire was almost as quickly subdued as it had sprung up." As a matter of fact, all that was consumed was the woodwork of the ventilator in the roof; and the door and windows were charred. The fire is attributed to an overflow of oil. At the time the fire broke out, the Manager (Mr. A. Waddell) was engaged with the Gas Committee in the Town Hall, some distance away; but he was sent for, and was soon on the spot. Perhaps "when the cat's away the mice will play" may have had something to do with the occurrence; for it seems to me that only carelessness could lead to an outbreak of fire from overflowing oil. Oil should not overflow, if looked after; but if it should happen to do so, then provision should be made for intercepting it before it got to the floor. If by any means oil should get on to the floor of the retort-house, hot ashes should not be wheeled past the place until the oil be dealt with. These are simple enough things to attend to; but unfortunately all workmen are not careful.

The Kilsyth Police Commissioners have accepted the tender of Messrs. Laidlaw, Sons, and Caine, of Glasgow, for the erection of a new double-lift gasholder, of 73,000 cubic feet capacity, the cost of which, including excavation, is expected to amount to over £1800.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST (see ante, p. 1056).

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
590,000	10	9 Apl.	10½	Alliance & Dublin 10 p. c.	23—25	..	4 4 0
100,000	10	,,	7½	Do. 7 p. c.	17½—18½	..	4 1 1
300,000	100	2 Jan.	5	Australian (Sydney) 5 % Deb.	108—111	..	4 10 11
200,000	10	29 Oct.	5	Belgrano (B. Ayres), Limited	9½—10	..	5 0 0
100,000	Stck.	30 Dec.	5	Do. 5 p. c. Deb. Stk	102—105	..	4 15 3
200,000	5	12 Nov.	6½	Bombay, Limited	6½—7½	..	4 6 8
40,000	5	,,	6½	Do. New, £4 paid	5—6	..	4 6 8
380,000	Stck.	26 Feb.	12	Brentford Consolidated	287—293	..	4 2 2
240,000	,,	,,	9	Do. New	223—228	..	3 18 7
50,000	,,	,,	5	Do. 5 p. c. Pref.	145—150	+2	3 6 8
159,375	,,	11 Dec.	4	Do. 4 p. c. Deb. Stock.	130—134	..	2 19 9
220,000	Stck.	25 Mar.	11½	Brighton & Hove Original	273—278	..	4 2 8
208,820	,,	,,	8½	Do. A Ord. Stk.	197—202	..	4 4 2
933,500	Stck.	26 Feb.	5	Bristol, 5 p.c. max.	130—135	..	3 14 1
420,000	20	26 Mar.	11½	British	56—57	−½	3 18 11
50,000	10	26 Feb.	11½	Bromley, Ordinary 10 p. c.	23—25	..	4 12 0
71,000	10	,,	8½	Do. 7 p. c.	18—20	..	4 5 0
500,000	10	28 Apl.	6	Buenos Ayres (New) Limited	9½—10*	..	6 0 0
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	101—103	..	5 16 6
150,000	20	26 Feb.	8½	Cagliari, Limited	29—31	..	5 6 5
100,000	10	30 Sept.	6	Cape Town & District, Ltd	16—17	..	3 10 7
50,000	50	3 May	6	Do. 6 p. c. 1st Mort.	57—59*	+3	5 1 8
550,000	Stck.	9 Apl.	13½	Commercial Old Stock	345—350	..	3 17 2
165,000	,,	,,	10½	Do. New do.	255—260	..	4 0 9
165,000	,,	11 Dec.	4½	Do. 4½ p. c. Deb. do.	150—155	..	2 18 0
800,000	Stck.	30 Dec.	13	Continental Union, Limited.	255—260	..	5 0 0
200,000	,,	,,	10	Do. 7 p. c. Pref.	215—220	..	4 10 11
51,600	Stck.	26 Feb.	14	Croydon Com'cial A 10 p. c.	317—322	..	4 6 11
163,400	,,	,,	11	Do. B 7 p. c.	255—260	..	4 4 7
535,000	Stck.	26 Feb.	5½	Crystal Palace Ord. 5 p. c. Stk	139—142	..	3 13 11
60,000	,,	,,	5	Do. 5 p. c. Pref.	140—143	..	3 9 11
486,090	10	29 Jan.	11	European, Limited	24½—25½	..	4 6 3
351,060	10	,,	11	Do. £7 10s. paid	17½—18½	..	4 9 3
5,876,590	Stck.	12 Feb.	12¾	Gaslight & Coke, A, Ordinary	309—314	+2	4 1 3
100,000	,,	,,	4	Do. B, 4 p. c. max.	110—114	..	3 10 2
665,000	,,	,,	10	Do. C, D, & E, 10 p. c. Pf.	310—315	+2	3 3 6
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	150—155	+5	3 4 6
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	220—225	+10	3 6 8
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	207—212	..	3 6 0
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	310—315	+3	3 3 6
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	182—187	..	3 4 2
1,061,150	,,	11 Dec.	4	Do. 4 p. c. Deb. Stk.	137—142	..	2 16 4
294,850	,,	,,	4½	Do. 4½ p. c. do.	150—155	..	2 18 1
908,000	,,	,,	6	Do. 6 p. c. do.	207—212	..	2 16 7
70,000	10	29 Oct.	6	Hongkong & China, Limited	12⅓—13½	..	4 8 11
3,800,000	Stck.	12 Nov.	10†	Imperial Continental	217—222	..	4 10 1
376,400	100	1 Feb.	4	Do. 4 p. c. Debs. Red.	100—103	..	3 17 8
473,600	Stck.	12 Feb.	3½	Do. 3½ p. c. Deb. Stk ,,	104—107	..	3 5 5
75,000	5	11 Dec.	6	Malta & Mediterranean, Ltd.	5¾—6¼	..	4 16 2
560,000	100	1 Apl.	5	Met. of Melbourne, 5 p. c. Deb.	111—113	..	4 8 6
250,000	100	,,	4½	Do. 4½ p. c. Debs.	107—109	..	4 2 7
541,920	20	12 Nov.	5	Monte Video, Limited	15—16	..	6 5 0
150,000	5	26 Nov.	8	Oriental, Limited	8½—9	..	4 8 11
135,000	5	,,	8	Do. New, £4 10s. paid	7½—8	..	4 10 0
15,000	5	,,	8	Do. do. 1879, £1 paid	1¾—2	..	4 0 0
60,000	5	26 Mar.	7	Ottoman, Limited	5—5½	..	6 7 3
420,000	100	3 May	6	People's Gas 1st Mtg. Bds.	101—106*	..	5 13 1
500,000	100	1 Dec.	6	of Chicago 2nd Do.	104—109	..	5 10 1
250,000	10	30 Sept.	10	San Paulo, Limited	14—15	+½	6 13 4
5,475,000	Stck.	26 Feb.	5½	South Metrop., 4 p.c. Ord.	141—144	..	3 12 11
1,416,667	,,	—	3	Do. 3 p.c. Deb. Stk.	104—106	..	2 16 7
60,000	Stck.	12 Mar.	11½	Tottenham & Edmonton, A	275—285	..	4 0 10
60,000	,,	,,	8½	Do. B	190—200	..	4 5 0
182,380	10	30 Dec.	10	Tuscan, Limited.	14—15	..	6 13 4
149,900	10	2 Jan.	5	Do. 5 p.c. Debs. Red.	101—103	..	4 17 1
				WATER COMPANIES.			
746,159	Stck.	30 Dec.	10½	Chelsea, Ordinary	324—329	−4	3 3 10
150,000	,,	,,	5	Do. 5 p. c. Pref.	175—180	..	2 15 6
160,000	,,	,,	4½	Do. 4½ p. c. Pref. Stk., 1875	158—162	..	2 15 6
175,785	,,	26 Mar.	4½	Do. 4½ p. c. Deb. Stock	160—165	..	2 14 6
1,720,560	Stck.	9 Apl.	7	East London, Ordinary	218—223	..	3 2 9
554,740	,,	30 Dec.	4½	Do. 4½ p. c. Deb. Stk.	164—169	..	2 13 4
390,000	,,	,,	3	Do. 3 p. c. Deb. Stk.	106—108	..	2 15 7
700,000	50	11 Dec.	7½	Grand Junction, 10 p.c. max.	112—117	..	3 4 1
295,000	Stck.	26 Mar.	4	Do. 4 p. c. Deb. Stk.	148—153	..	2 12 4
708,000	Stck.	12 Feb.	12	Kent	340—345	..	3 9 7
160,000	,,	,,	7	Do. New, 7 p. c. max.	212—217	..	3 4 6
1,043,800	100	30 Dec.	9½†	Lambeth, 10 p. c. max.	274—279	+2	3 9 10
406,200	100	,,	7½	Do. 7½ p. c. max.	220—225	..	3 6 8
350,000	Stck.	26 Mar.	4	Do. 4 p. c. Deb. Stk.	147—150	..	2 13 4
500,000	100	12 Feb.	13	New River, New Shares	420—425	..	3 1 1
1,000,000	Stck.	29 Jan.	4	Do. 4 p. c. Deb. Stk.	152—155	..	2 11 7
902,300	Stck.	30 Dec.	6	S'thwk & V'xhall, Ordinary	155—160	..	3 15 0
126,500	100	,,	6	Do. Do. 7½ p. c. Max.	150—155	..	3 17 5
489,200	Stck.	,,	5	Do. Do. 5 p. c. Pref.	175—180	..	2 15 7
1,019,585	,,	9 Apl.	4	Do. 4 p. c. A Deb. Stk.	145—148	..	2 14 2
1,155,066	Stck.	11 Dec.	10	West Middlesex	310—315	..	3 3 6
200,000	,,	,,	4½	Do. 4½ p. c. Deb. Stk.	163—168	..	2 13 7

† Next Dividend will be at this rate. *Ex div.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *May* 8.

Sulphate of Ammonia.—There has been no very special feature in the market. There was a little weakness early in the week; but further requirements for prompt delivery having to be covered, and supplies being found somewhat scarce, a firmer tone has again supervened. Closing quotations are £7 10s. to £7 11s. 3d. per ton f.o.b. Leith and Hull, and £7 13s. 9d. per ton f.o.b. Liverpool. For forward delivery, speculators continue to depress the market by making dangerously low quotations.

LONDON, *May* 8.

Tar Products.—Benzols are again quoted lower; but there are no sellers at the prices dealers are quoting. There is a slackness about the whole market which is remarkable, seeing that the production is rapidly falling off. Carbolic acid, however, as well as cresylic acid, are the only exceptions which show any life and activity. Pitch is hanging; and anthracene is at the moment a dead letter—some outside lots changing hands at absurd prices.

To-day's prices are as follows: Tar, 15s. to 20s. Pitch, 20s. to 22s. 6d. Benzol, 90's, 1s. 10½d.; 50's, 2s. 3½d. Toluol, 2s. 8d. Solvent naphtha, 1s. 7d. Crude, 30 per cent., naphtha (naked), 1s. Creosote, 1⅛d.; liquid, 1⅞d. Heavy oils, 35s. Carbolic acid, 2s. 6d. Pressed naphthalene, 57s. 6d. Creosote salts, 25s. Anthracene, "A quality," 7d.; "B," 5d. to 6d.

Sulphate of Ammonia is difficult to define. There are considerable shipments going on from some ports; and in others, business is quiet and without inquiry. But, taken all round, values may be reckoned at £7 8s. 9d to £7 12s. 6d., depending on port of shipment—in all cases, less 3½ per cent.

Daventry Water Scheme.—The Daventry Town Council agreed yesterday week to make application to the Local Government Board for a loan of £6000 to carry out the water scheme prepared by Mr. J. Eunson, of Northampton.

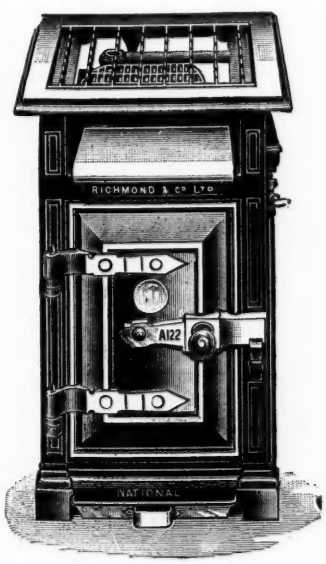
San Paulo Gas Company, Limited.—At the annual general meeting of this Company next Tuesday, the Directors will report a profit of £27,708 available for division, as the result of the working in the past year. An interim dividend to the amount of £12,500 was paid in September; leaving a balance of £15,208 to be dealt with. The Directors will recommend the payment of a final dividend of 5 per cent., free of income-tax, absorbing a further sum of £12,500, and making 10 per cent. for the year; the placing to the reserve account of £1229, increasing it to £41,000; and carrying forward the balance of £1479 The business shows a satisfactory increase; and the works and plant have been kept in thorough repair. As the Company's concession will expire in October, the Government invited tenders from all parts of the world; but the Directors are informed that none whatever have been received. Negotiations are consequently now in progress between the Government and the Company for the renewal of the concession on satisfactory and advantageous terms.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—As the season advances for the placing out of gas coal contracts, it is becoming more evident, as previously intimated in these reports, that no very substantial advance on last year's low rates is likely to be obtained. In a few odd cases, something like 3d. per ton above the specially low prices which were accepted last season has been secured; but generally the basis on which contracts of any importance could be obtained would seem to be tending to practically 1896 prices, with perhaps here and there a slight hardening. An unsatisfactory feature in the market, so far as colliery owners are concerned, is that with regard to the locomotive fuel contracts. It is reported that the London and North-Western Railway Company have already secured a considerable portion of their supplies on the excessively low basis of last year—representing an average of 5s. 9d. per ton at the pit mouth for locomotive fuel. There is little doubt that further contracts yet to be placed will have to follow on much the same lines. The demand for the better qualities of round coal is necessarily slackening off; but there is no actually quoted giving way in prices, though the tendency is in a weakening direction. Common round coals are plentiful. At the pit mouth, best Wigan Arley only in very exceptional cases is fetching more than 10s. per ton; Pemberton four-feet and seconds Arley do not average above 8s. to 8s. 6d.; and steam and forge coals 5s. 9d. to 6s. 3d. For shipment, steam coal can be bought at from 7s. 3d. to 7s. 9d. per ton, according to quality, delivered at the Mersey ports. The anything but encouraging outlook for the coal trade is receiving the serious consideration of colliery owners; and at a meeting held in Manchester last week, the question of a restriction of the output was discussed. Though it was generally admitted that the excess of supplies over requirements was the chief cause of the present depression in the trade, and that some limitation of the output was advisable, no definite decision was come to with regard to any general curtailment of production at the collieries. Engine fuel continues in brisk request; and with supplies not over plentiful, prices are gradually hardening—advances of 3d. per ton being secured in special cases But as yet there has been no really general upward move. At the pit mouth, common slacks are averaging about 3s. 3d. to 3s. 6d. per ton; medium, 3s. 9d. to 4s. 3d.; and best qualities, 4s. 9d. to 5s.

Northern Coal Trade.—There is a fuller demand for north-country coals, both for export and for some branches of local consumption. Most of the Baltic and northern ports are now giving fuller employment to the steam and gas-coal collieries; there being occasionally long loading turns at collieries that export a considerable part of their production. Best steam coals are firm; and from 8s. 6d. to 8s. 9d. per ton f.o.b. is now the ruling price. Second-class steam coals are 8s. to 8s. 3d. per ton; and steam smalls, 4s. Manufacturing coals are firmer, and in good demand; but sales are chiefly on long contracts. In regard to gas coals, there is a fuller inquiry for export; and some of the collieries that took Russian and Scandinavian gas coal contracts, are now fully occupied. Prices are steady, on the basis of 6s. 6d. to 7s. per ton f.o.b. for best



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Durham gas coals; but the deliveries are still largely on contracts. The gas coke trade shows little variation in price this week; but with a reduced output, the stocks of coke at the inland gas-works are now beginning to be decreased.

Scotch Coal Trade.—The state of the coal market remains unchanged. Trade is good for all sorts; splint being in least demand. The export trade is improving. There is no appearance of discontent among the miners, who are working full time. Usually before this period of the year the retail prices of coal are formally reduced by 1s. per ton; but this season there is no indication of the step being taken. The prices quoted are: Main, 6s. 6d. per ton f.o.b. Glasgow; ell, 7s. to 7s. 3d.; and splint, 6s. 6d. to 7s. The shipments for the past week amounted to 166,994 tons—a decrease of 10,070 tons as compared with the preceding week, and of 23,346 tons compared with the corresponding week last year. For the year to date, the shipments have been 2,328,908 tons—an increase over the same period of last year f 115,633 tons.

A Sequel to the Oil-Gas Question in Bradford.—At a meeting of the Bradford Corporation Gas and Electric Committee, last Friday, a letter was read from Dr. Dvorkovitz, the patentee of the oil-gas producing process, which the Corporation accepted some 18 months ago on trial, claiming £1500. The Committee decided to ignore the claim, and to call upon the Syndicate to remove the plant.

The Public Lighting of Canterbury.—The Canterbury Town Council last Wednesday accepted a proposal of the Lighting Committee that a minute of the Whole House Committee of March 24 as to experimental incandescent lighting should be rescinded, and that a recent offer by the Gas Company should be agreed to—viz., the present burners, to consume 5 cubic feet of gas per hour, to be reduced from £3 10s. to £3 5s. per lamp per annum, with a proportionate reduction on the Sugg lamps in use; the contract to run for two years from the expiration of the last one.

Gas Profits and the Rates at Rochdale.—The accounts of the Gas Committee of the Rochdale Corporation for the past financial year show that the profits amount to £5728, as compared with £6619 last year—a decrease of £891. This reduction is principally attributed to the greatly reduced prices obtained for residual products; but there is also a decrease of £189 in the total of the gas-rental—the figures being £49,086, against £49,275 reported twelve months ago. At the monthly meeting of the Town Council last Thursday, the annual financial statement was made by Alderman Cheetham. The estimates last year amounted to £73,150; and the actual expenditure was £72,999, or £151 less. The estimated expenditure this year, as compared with last, showed a net increase of £5215, towards which they had a balance in hand of £1384, and last year's gas profits amounting, as stated above, to £5728. These two made a total of £7112, which left £71,253 to be provided from the rates, as against £61,555 last year. There would be an increase of 4d. in the pound in the rates, bringing them up to 6s. 6d. The estimates were approved.

The Ledbury Water Scheme.—The Local Government Board have refused to sanction a loan of £5000 for the Ledbury water scheme, as they consider the supply would not be adequate. The Board recommend the Council to go to Bromesberrow Heath for a supply.

The New Retort-House Rules at the Leeds Gas-Works.—A conference took place last Friday between the Gas Committee of the Leeds Corporation and representatives of the men with reference to the dispute at the New Wortley works. The Committee thought the new rules were reasonable, and declined to alter them. A meeting of the men will be held to-day to consider the decision.

Uckfield Gas Company.—The annual report of this Company, presented at the meeting of the shareholders last Wednesday, shows an improvement in the business. The gas-rental amounted to £1051, which is an advance of about £200. The residuals account maintained its position during the year. On account of expenditure on the works, a lower dividend was paid last year; but an increased dividend was declared on this occasion, so as to make an average of 7 per cent. for the two years. It was also decided to establish a reserve fund; and for this purpose £250 of the balance of profit was appropriated. From June 24, the price of gas is to be reduced from 5s. to 4s. 9d. per 1000 cubic feet.

Bishop's Teignton Water Supply.—An inquiry was held last Thursday at Bishop's Teignton, by Mr. Walter A. Ducat, an Inspector of the Local Government Board, respecting an application by the Newton Abbott Rural District Council for sanction to a loan of £800 for works of water supply. It was stated by Mr. J. Alsop, the Clerk to the Council, that works were provided in 1886 for the supply of the village, but that consequent on the growth of the population and the failure of a spring these were now inadequate. It was proposed to utilize another spring, and construct a new reservoir capable of holding 90,000 gallons of water, and to connect this by a 2-inch pipe with the main leading to the village. Mr. S. Segar produced and explained the plans; and the Inspector afterwards visited the site of the present and the proposed works.

Manchester Corporation Finances.—At the quarterly meeting of the Manchester City Council last Wednesday, Alderman King presented the estimates for the year ending March next. He explained that on last year's total estimate on the city fund account of £840,892, there was a saving of £41,701, or nearly 5 per cent. The estimates for the current year amounted to £848,703—an increase of £7811, or less than 1 per cent. over those for the past year. Deducting the £41,708 underspent, the amount required to be raised by the city rate was £806,995; and as the amount required in 1896, after deducting the previous year's saving, was £808,446, there was a decrease of £1451 in the present year's rate. The average city rate would be about 5s. 10¾d., against 5s. 11½d. in 1896—a decrease of ¾d. in the pound, which, small as it was, was not unacceptable. There is an increase of £13,577 in the receipts in aid of the rates. The Gas Committee propose to pay over to the city fund the sum of £50,700, against £40,000 last year; the Electricity Committee's contribution remaining at £10,000.

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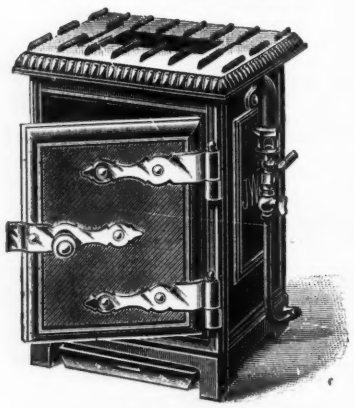

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Water Scheme for Mansfield Woodhouse.—Last Wednesday, a Local Government Board inquiry was held at Mansfield Woodhouse by Mr. R. Walton, one of the Inspectors, with reference to an application made by the last District Council for sanction to borrow £3000 for the purpose of providing a new water supply for the parish. The project is opposed by a majority of the present Council.

The Davis Gas-Stove Company and Messrs. C. Wilson and Sons held an exhibition at Hull last week, in connection with the British Gaslight Company. Miss Gertrude Knott was the cookery demonstrator.

Messrs. Richmond and Co., of Warrington, have been, since Monday last week, holding an exhibition of gas appliances in the Corn Exchange, Coventry, The usefulness of their cooking ranges has been demonstrated twice daily by Miss E. Fry, before appreciative audiences.

Messrs. W. Parkinson and Co. held very successful gas exhibitions last week in the Town Hall, Hemel Hempstead, from Monday to Wednesday, and in the Corner Hall, Boxmoor, on Thursday and Friday. Miss Edith Sanderson gave lectures on cookery twice daily at each exhibition.

The annual general meeting of the Australasian Incandescent Gaslight Company, Limited, was held last Friday, when a dividend of 24 per cent., free of income-tax, was declared, and 15 per cent. was written off the patents account. This is the third consecutive year in which 24 per cent. has been paid.

An exhibition organized by the Cannon Hollow-Ware Company, of Deepfields, Staffordshire, has lately been held in the Temperance Institute, Southport. One side of the large hall was entirely occupied by a selection of the manufactures of the firm; chief among them being the "Hercules" gas-cookers. The lectures were in the experienced hands of Madame Alting-Mees.

An exhibition of gas and other appliances has been held at Wrexham; the principal exhibitors being Messrs. J. Wright and Co., Limited, of Birmingham. The convenience and cleanliness of gas cooking were well demonstrated by Miss J. Barker. The same firm held a gas exhibition at St. Margaret's Hall, Dunfermline, on four days of last week. Miss Nellie Parker was the lecturer.

As will be seen by our advertisement columns, Mr. Alfred Richards will offer for sale on the 26th inst. 500 Southend Water Company's shares and a similar number of Harrow and Stanmore Gas Company's shares (both new issues), as well as stocks and shares in the Brentford, Hornsey, Wandsworth and Putney, Tunbridge, and Barnet Companies. As already announced, Messrs. Edwin Fox and Bousfield will offer for sale, to-morrow, by order of the Directors, £10,000 of 3 per cent. debentures of the Crays Gas Company.

On the occasion of the visit of the Institution of Gas Engineers to the Rotherhithe works of the South Metropolitan Gas Company last Friday, the members had an opportunity of inspecting the gasholder which is in course of reconstruction by Messrs. Willey and Co., of Exeter, to the designs of Mr. F. Livesey, the Company's Chief Engineer. It is rather more than 100 feet in diameter; and it has five 20 feet lifts, two of which rise above the guide-framing. The latter consists of 13 V-shaped trellised standards, with 39 trellised girders. The existing masonry tank has been deepened 7 feet by means of wrought-iron plates.

On behalf of a Syndicate which has been formed with the view of re-opening the submerged mines at the Cannock and Huntington Colliery, near Cannock Chase, an order has been given to Messrs. Joseph Evans and Sons, of the Culwell Foundry, Heath Town, to supply some of their Cornish pumps. Messrs. Evans have also booked a further order for supplying two additional pumps to the Dover sinkings, where the disaster lately occurred. Another undertaking in which the firm have just been successful is the supply of Cornish pumps which have drained the large Talysarn slate quarries, near Carnarvon, after many unsuccessful attempts to do the work.

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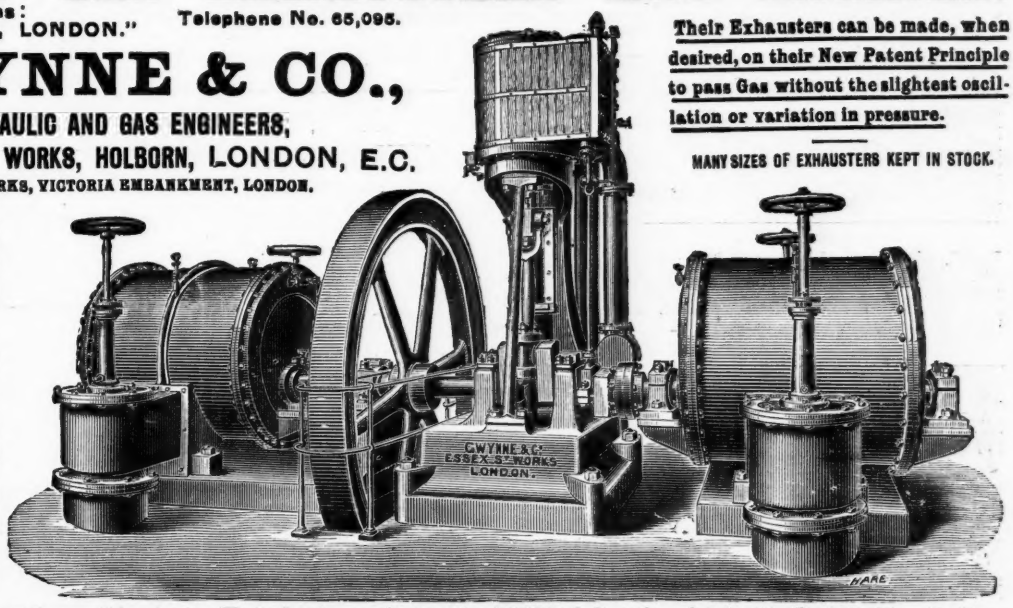

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[For Illustrated Advertisement, see May 4, p. 1020.]

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Printed forms, upon which application must be made, can be obtained at my Office, or will be sent upon receipt of a stamped addressed foolscap envelope.
Applications, accompanied by *copies* (which will not be returned) of not more than three Testimonials of recent date, must reach me not later than May 29, 1897, endorsed "Gas Engineer and Manager."
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ALEX. WALKER,
Manager.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also COMPLETE WORKS equal to 7000, 20,000, 60,000 cubic feet per diem. **Inquire and compare Prices and Particulars before ordering elsewhere.**
J. F. BLAKELEY, Gas Engineer, Ravensthorpe, YORKS.

FOR SALE, cheap—
One TELESCOPIC GASHOLDER, 32 ft. diameter, with two lifts 14 ft. deep each; Capacity, 24,500 cubic feet, with Wrought-Iron Tank complete.
One CAST-IRON SCRUBBER, 38 ft. 6 in. by 6 ft. diameter.
Two PURIFIERS, 8 feet square, complete, with 6-inch Bye-Pass Valves and Connections.
EXHAUSTERS, 5000 to 60,000 cubic feet per hour.
We would undertake to re-erect any of the above, if desired.
Photos, Particulars, and Prices of above on application to SAML. WHILE AND SONS, 60, Queen Victoria Street, LONDON, E.C.

COMPLETE GAS PLANT FOR SALE.

TO BE SOLD separately, or in one lot—
Two Double-Lift HOLDERS, 34 ft. 4 in. diameter outer, 32 ft. 10 in. inner, 14 ft. 3 in. deep, with Pipes, &c.
One GOVERNOR, SYPHON-BOXES, VALVES, &c.
One STATION METER, with Valves (new), Braddock's make.
One Set of four PURIFIERS, 7 ft. square by 4 ft. deep, Walker's make, with Grids and one of their Centre-Valves, Connections, and Lifting Gear.
One TAR-PUMP and STORE BOILER.
One "ECLIPSE" WASHER-SCRUBBER, Laycock and Clapham, with Pulleys and Governor, erected in 1890.
One EXHAUSTER, with 12-inch Valves and Connections.
One Horizontal CONDENSER, with fourteen 8-inch Pipes, 18 ft. long, with Bye-Pass, Valves, and Connections.
Twenty RETORT MOUTHPIECES, with Lids and Duplicates, Dip, Ascension, and Bridge Pipes, Hydraulic Main and Valve, Fire-Doors, Buckstaves, and Tie-Rods.
12-inch and 8-inch MAINS, at per ton.
12-inch VALVES, at each.
For further Particulars and Prices, apply to H. I. WILLIAMS AND Co., Kidsgrove, STOKE-ON-TRENT.

THE Corporation of Middleton are pre-pared to receive TENDERS for RAISING the ROOF of the RETORT-HOUSE at their Gas-Works.
Plans, &c., may be seen, and Specifications obtained, on application to Mr. T. Duxbury, Gas Manager, after Wednesday, the 5th of May, between the hours of 9.30 and 11.30 a.m.
Tenders, endorsed "Tender for Raising Roof," and addressed to the Chairman of the Gas Committee, to be delivered at my Office not later than Wednesday, the 19th of May, 1897.
The Corporation do not bind themselves to accept the lowest or any tender.
FREDERICK ENTWISTLE,
Town Clerk.
Town Clerk's Office, Middleton,
April 29, 1897.

INVESTMENTS IN GAS.

FOR SALE—Parcels of Shares in well-known PROVINCIAL GAS COMPANIES: Southampton, paying 10 per cent.; Portsea, paying 10 per cent.; Exeter, paying 10 per cent.; Havant, paying 9 per cent.; Bristol (maximum Stock); Dorking, paying 10 per cent.; Bournemouth; Guildford.

Full Particulars of Messrs. LOVE AND COOPER, Stock and Share Brokers, PORTSMOUTH.

CORPORATION OF WALSALL.

TENDERS FOR GAS COAL.

THE Corporation of Walsall invite TENDERS for the supply of 44,000 Tons of STAVELEY, YORKSHIRE, or any other good GAS COAL, to be delivered during One Year from the 1st of July next, at the Corporation Siding at the Pleck Gas-Works, Walsall, as may be required.

Forms of Tender and Specification may be obtained on application to the undersigned.

The Corporation do not bind themselves to accept any tender; and they reserve the right to divide the Contract between several firms.

Tenders, sealed and marked outside "Tender for Gas Coal," and stating the price for large Coal and also for Nuts, are to be sent to the undersigned on or before Saturday, the 29th of May inst.

JOHN R. COOPER,
Town Clerk.

Borough Offices, Walsall,
May 7, 1897.

TO LIME MASTERS.

THE Corporation of Walsall invite TENDERS for the supply of about 800 Tons of LIME, which will be required at their Gas-Works during One Year from the 1st of July next; the deliveries to be in such monthly quantities as the Manager of the Gas-Works may from time to time direct.

The Lime is to be Hand-picked, and clear from Refuse and Ashes, and to be delivered at the Corporation Siding at the Pleck Gas-Works as required.

Payments monthly.

Tenders, sealed and marked outside "Tender for Lime," are to be sent to the undersigned on or before Saturday, the 29th of May inst.

JOHN R. COOPER,
Town Clerk.

Borough Offices, Walsall,
May 7, 1897.

THE URBAN DISTRICT COUNCIL OF LYMM.

THE above Council are prepared to receive TENDERS for the supply of GAS COAL, to be delivered at their Gas-Works in Lymm, for a term of One Year from the 1st day of July, 1897.

The probable quantity required will be about 1400 tons, which must be freshly wrought, and well screened, and free from Sulphurous Pyrites or other objectionable matter; but the Council reserve the right of increasing or decreasing the quantity named.

The person whose tender is accepted will be required to enter into an Agreement with the Council for the due performance of his Contract.

Sealed tenders, stating price per ton delivered alongside the Works, to be sent to Wm. Mullard, Esq., Clerk to the Council, on or before the 25th day of May, 1897, endorsed "Coal Tender."

The Council have no special Form of Tender, and do not bind themselves to accept the lowest or any tender.

Further Particulars may be had on application to

ROBERT SURTEES,
Gas Manager.

Lymm, Cheshire,
May 1, 1897.

THE URBAN DISTRICT COUNCIL OF LYMM.

THE above Council are prepared to receive TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR made at their Gas-Works, for a term of One Year from the 1st day of July, 1897.

The Tar and Liquor will be delivered free into Contractor's Boat on the Bridgewater Canal.

The Purchaser will have to enter into an Agreement with the Council for the due performance of his Contract.

Sealed tenders, stating price per ton for Tar and price per ton for Liquor (5° Twaddel), to be sent to Wm. Mullard, Esq., Clerk to the Council, on or before the 25th day of May, 1897, endorsed "Tar Tender."

The Council do not bind themselves to accept the highest or any tender.

Further Particulars may be had on application to

ROBERT SURTEES,
Gas Manager.

Lymm, Cheshire,
May 1, 1897.

CARDIFF GASLIGHT AND COKE COMPANY.

TENDERS FOR COAL.

THE Directors of the above Company are prepared to receive TENDERS for a supply of 45,000 Tons of best well-screened large GAS COAL, to be delivered between July, 1897, and the 30th of June, 1898, in monthly quantities, in accordance with the Specification.

Parties tendering may do so for the whole quantity, or for quantities from 5000 Tons upwards.

Forms of Tender and Specification of monthly deliveries may be obtained on application to the Engineer and Manager, Mr. H. Morley, M.Inst.C.E.

Sealed tenders to be sent to the undersigned not later than Ten a.m., Tuesday, the 25th day of May next, addressed to the Chairman of the Company, and endorsed "Tender for Coal."

The Directors do not bind themselves to accept the lowest or any tender, and reserve to themselves the right to apportion the whole quantity as they may think fit.

By order,
GEORGE CLARRY,
Secretary.

Gas Offices, Cardiff,
April 24, 1897.

BOROUGH OF CONGLETON.

THE Gas Committee invite Tenders for the supply of 3500 Tons of screened GAS COAL, NUTS, BEANS, &c., and 250 Tons of screened CANNEL or CANNEL NUTS, to be delivered between the 1st of July, 1897, and the 30th of June, 1898.

Further Particulars may be obtained from the undersigned.

Sealed tenders, endorsed "Tender for Coal," addressed to the Chairman of the Gas Committee, to be delivered at the Town Clerk's Office, not later than Wednesday, June 2,

WM. ORME,
Manager.

TAR AND LIQUOR.

THE Gas Committee of the Borough of Congleton are prepared to receive TENDERS for the purchase of the surplus TAR and AMMONIACAL LIQUOR to be produced at their Gas-Works from July 1, 1897, to June 30, 1898.

Further Particulars may be obtained from the undersigned.

Sealed tenders, endorsed "Tar and Liquor," addressed to the Chairman of the Gas Committee, to be delivered at the Town Clerk's Office not later than Wednesday, June 2.

WM. ORME,
Manager.

HAWORTH URBAN DISTRICT COUNCIL.

TENDERS are invited by the above Council for the supply of 2000 Tons of unscreened GAS COAL, to be delivered (in such quantities as the Council may determine) on Rails at Haworth Railway Station within the ensuing Twelve Months.

Sealed tenders to be forwarded to me the undersigned, marked "Coal Tender," not later than the 27th inst.

WM. ROBERTSHAW,
Clerk.

Burlington Chambers, Keighley,
May 6, 1897.

THE Directors of the Farnworth and Kearsley Gas Company are prepared to receive TENDERS for the surplus TAR and AMMONIACAL LIQUOR produced at their Works, together or separately, for One Year.

Sealed tenders, addressed to the Chairman, J. W. Watkinson, Esq., to be delivered on or before Monday, May 24.

Forms of Tender and any further Information required may be obtained from the undersigned.

T. L. SHEPPARD,
Manager.

URBAN DISTRICT COUNCIL OF DUKINFIELD.

TENDERS FOR GAS COAL.

THE Gas Committee require Tenders for 7000 Tons of GAS COAL, to be delivered by Road, Rail, or Canal, commencing on the 1st of May next, and concluding the 30th of June, 1898. None but fresh-got screened best quality GAS COAL, free from faults, need be offered; and no Testimonials or Analyses are required.

No tender will be considered which may be received after Twelve noon on Monday, the 31st of May.

Sealed envelopes, endorsed "Coal," to be directed to the Chairman of the Committee, Mr. Councillor Stafford, Gas Offices, Charles Street, Dukinfield.

Tender Forms and further Particulars on application to

HARRISON VEEVERS, C.E.,
Engineer and Secretary.

Dukinfield, April 27, 1897.

COUNTY BOROUGH OF HUDDERSFIELD.

TENDERS FOR GAS COAL AND NUTS.

THE Gas Committee are prepared to receive TENDERS, from Colliery Proprietors only, for the supply and delivery of from 50,000 to 60,000 Tons of UNSCREENED GAS COAL and SCREENED NUTS for a period of Twelve Months, commencing the 30th of September next.

Full Particulars and Form of Tender may be obtained on application to the Engineer and Manager, Mr. E. A. Harman, Gas-Works, Huddersfield.

Sealed tenders, endorsed "Tender for Gas Coal," must be delivered free of charge, addressed in the handwriting of the tenderer or his agent, to the Town Clerk, Town Hall, Huddersfield, and delivered not later than Tuesday, the 25th day of May, 1897.

The Corporation do not bind themselves to accept the lowest or any tender.

By order,
F. C. LLOYD,
Town Clerk.

Town Hall, Huddersfield, May 7, 1897.

EXMOUTH GAS COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the Exmouth Gas Company invite TENDERS for 6500 Tons or 3500 Tons (at their option for One or Two Years) of clean, unscreened (through and through) first-class NEWCASTLE, DURHAM, or ALDWARKE MAIN GAS COAL, to be shipped in such quantities (by Sailing Vessels only), and at such times as may be required, commencing from the 1st of August next.

Tenders to be accompanied by Working Analysis; and Prices may be quoted c.i.f. or f.o.b. at Exmouth Docks.

Sealed tenders to be sent to the undersigned, addressed to the Chairman of the Company, and endorsed "Tender for Coal," not later than Saturday morning, the 29th day of May next.

The Directors reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any tender (no special Form of Tender issued).

By order,
JAMES T. FOSTER,
Secretary and Manager.

Gas-Works, Exmouth,
May 7, 1897.

BOROUGH OF BURTON-UPON-TRENT.

TO COLLIERY PROPRIETORS.

THE Mayor, Aldermen, and Burgesses of the Borough of Burton-upon-Trent, acting by the Council, are prepared to receive TENDERS from Colliery Proprietors for the supply of 25,000 Tons, or a portion thereof, of best screened GAS COAL.

Forms of Tender and Conditions of Supply may be obtained upon application at my Office; and sealed tenders, endorsed "Coal," are to be delivered to me at or before Ten a.m. on the 26th day of May inst.

The Council do not bind themselves to accept the lowest or any tender.

F. L. RAMSDEN,
Manager and Engineer.

Gas and Electric Light Works,
Wetmore Road, Burton-upon-Trent,
May 10, 1897.

GUILDFORD GASLIGHT AND COKE COMPANY

TO COAL MERCHANTS.

THE Directors of the above Company are prepared to receive TENDERS for the supply of 5000 to 7000 Tons of YORKSHIRE GAS COAL, to be delivered free at Guildford Station during the period of One Year from July 1, 1897, to June 30, 1898, in such quantities and at such times as required.

The Directors reserve the right to accept the whole or any portion of the quantity offered, and do not bind themselves to accept the lowest or any tender.

Tenders to state the name of the Coal offered, to be endorsed "Tenders for Coal" and to be sent to Mark Smallpeice, Esq., Chairman of the Gas Company, Guildford, on or before Wednesday, May 19, 1897.

By order,
WILLIAM TITLEY,
Secretary.

Gas Office, Guildford,
May 4, 1897.

TO COAL MERCHANTS, SHIP OWNERS, AND OTHERS.

THE Directors of the Torquay Gas Com- pany are prepared to receive TENDERS for the supply for One, Two, or Three Years of about 14,000 Tons per year (or such other quantity as may be agreed on) of best approved GAS COAL.

Tenders to state the price of the Coal and the freight to Dartmouth or Torquay, separately and together, and also for delivery into the Company's Works adjoining the Great Western Railway, free of all charges.

Payment by cash for freight on delivery and by three months' Bills for the Coal.

Further Particulars to be obtained from Mr. Beynon, the Manager of the Company, Hollacombe, Paignton; and tenders to be sent to the undersigned on or before the 22nd inst.

Forms of Tender to be obtained from the Manager, on payment of a fee of 10s. 6d., returnable on receipt of a *bond-fide* tender.

JOHN KITSON,
Secretary.

Torquay, May 4, 1897.

MANSFIELD CORPORATION.

(GAS DEPARTMENT.)

TENDERS FOR GAS COAL & CANNEL.
TENDERS FOR TAR & AMMONIACAL LIQUOR.

COAL.

THE Gas Committee are prepared to receive TENDERS for 1500 Tons of CANNEL and 6500 Tons of best screened GAS COAL, delivered at Mansfield Station, for One Year, from the 1st of June, 1897, to the 31st of May, 1898.

TAR AND LIQUOR.

TENDERS for TAR and LIQUOR made during the Year, from the 1st of July, 1897, to the 30th of June, 1898. Tenders for Liquor to be made either at a fixed price per Ton or on the Sliding-Scale regulated by the price of Sulphate.

Tenders, endorsed, to be sent to J. Harrop White, Esq., Deputy Town Clerk, Mansfield, on or before the 24th of May, 1897.

Particulars and all other Information from the undersigned.

No special Form of Tender provided.

The Committee do not bind themselves to accept the lowest or any tender.

ARTHUR GRAHAM,
Engineer and Manager.

Gas-Works, Mansfield,
May 4, 1897.

GLOUCESTER GASLIGHT COMPANY.

TENDERS FOR GAS COAL.

THE Directors of the above Company invite TENDERS for the supply of about 24,000 Tons of GAS COAL for One Year from the 1st day of July next, in such monthly quantities as may be required by the Company.

Tenders to state the price delivered at the Midland Railway Wharf, High Orchard, or the Great Western Railway Wharf, Llanthony, Gloucester; or if sent (as preferred) by Water, the price f.o.b., and also the price delivered at the Gas Company's Wharf on the Gloucester and Berkeley Canal.

Further Particulars and Forms of Tender may be obtained of the Company's Engineer, Mr. R. Morland.

Sealed tenders, endorsed "Tender for Coal," specifying the description and quality of the Coal, to be addressed to the Chairman, Gas Offices, Eastgate Street, Gloucester, and delivered not later than the 29th day of May inst.

The Directors reserve to themselves the right to accept the whole or any portion of any quantity offered, and do not bind themselves to accept the lowest or any tender.

By order,
WILLIAM E. VINSON,
Secretary.

Gas Offices, Gloucester,
May 6, 1897.

TENDERS FOR COAL.

THE Directors of the Harlow and Sawbridgeworth Gaslight and Coke Company invite TENDERS for about 1000 Tons of good GAS COAL, delivered at Harlow Station free, in quantities of not less than 50 Tons. No Forms.

Tenders, addressed to the Secretary, Gas Company, Harlow, to be sent in on or before Tuesday, June 1, 1897, and to be sealed and endorsed "Tender for Coal."

COUNTY BOROUGH OF OLDHAM.

THE Gas-Works Committee are pre- pared to receive TENDERS for the supply of about 111,000 Tons of COAL and CANNEL required by them during the Year ending the 30th of June, 1898.

Specifications and Forms of Tender can be obtained on application to Mr. Arthur Andrew, Gas and Water Offices, Oldham, to whom tenders are to be sent on or before Tuesday, the 25th inst.

A. NICHOLSON,
Town Clerk.

May 7, 1897.

THE Directors of the Petworth Coal Gas and Coke Company invite TENDERS for the supply of 750 Tons of good GAS COAL, to be delivered free at Petworth Station, (L.B. & S.C. Railway), when required between July, 1897, and July, 1898.

Sealed tenders, endorsed "Coal," to be sent to the Secretary on or before Wednesday, May 26, 1897.

The Directors do not bind themselves to accept the lowest or any tender.

No tender forms supplied.

C. H. DOWNS,
Secretary.

Petworth, May 10, 1897.

THE Gas Committee of the Heywood Corporation invite TENDERS for the supply of 600 yards of 3-inch CAST-IRON PIPES and SPECIALS.

Specification and Form of Tender may be obtained on application to Mr. W. Whatmough, Gas Manager.

Sealed tenders, endorsed "Iron Pipes," to be sent to me not later than Tuesday, May 18, 1897.

By order,
J. H. BALDWICK.
Town Clerk.

Municipal Buildings, Heywood,
April 30, 1897.

THE Urban District Council of Hindley are prepared to receive TENDERS for CAST-IRON GAS-PIPES, JUNCTIONS, BENDS, SPECIALS, and GAS-WELLS, and for fixing same at their Gas-Works, Hindley.

Full Particulars can be obtained on application to Mr. Dickinson, Gas and Water Manager.

Tenders to be sealed and endorsed "Gas-Pipes," and lodged with the undersigned not later than May 17, 1897.

By order,
STEPHEN HOLT,
Clerk to the Council.

Council Offices, Hindley,
May 1, 1897.

COUNTY BOROUGH OF SALFORD.
(GAS DEPARTMENT.)

TENDERS FOR COAL AND CANNEL.

THE Gas Committee invite Tenders for the COAL and CANNEL required at their Works during a period of One or Two Years.

Forms of Tender may be obtained on application to the Gas Engineer, Gas Offices, Bloom Street, Salford.

Sealed tenders, endorsed "Tender for Coal," addressed to the Chairman of the Gas Committee, to be delivered to me before Three p.m., on Thursday, May 20, 1897.

By order,
SAML. BROWN,
Town Clerk.

Town Hall, Salford,
May 5, 1897.

CORPORATION OF MANCHESTER.

TENDERS FOR COAL AND CANNEL.

THE Gas Committee are prepared to receive, on or before Thursday, the 3rd of June next, OFFERS of high-class CANNELS and COALS, suitable for Gas making, for delivery at their Gaythorn, Rochdale Road, and Bradford Road Works, during a period of One, Two, or Three years, commencing the 1st of July, 1897 for CANNEL, and the 1st of October, 1897, for COAL.

Particulars and printed Forms of Tender may be obtained on application (in writing only) to Mr. Charles Nickson, Superintendent, Gas Department, Town Hall, Manchester.

By order of the Gas Committee,
WM. HENRY TALBOT,
Town Clerk.

Town Hall, Manchester,
May 1, 1897.

LINCOLN CORPORATION.
(GAS DEPARTMENT.)

TENDERS FOR TAR.

THE Gas Committee of the Corporation of Lincoln are prepared to receive TENDERS for the purchase of the surplus TAR (about 800 Tons) produced at their Works during the period of One Year, commencing on the 1st of July, 1897.

Sealed tenders, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Residuals," must be delivered at the Gas Offices, Lincoln, on or before the 22nd inst.

The Committee do not bind themselves to accept the highest or any tender.

Other Particulars may be obtained of the undersigned.

JNO. CARTER,
Manager.

Gas-Works, Lincoln,
May 8, 1897.

IMPERIAL CONTINENTAL GAS ASSOCIATION.
(INCORPORATED BY ACT OF PARLIAMENT.)

NOTICE is Hereby Given, that the HALF-YEARLY ORDINARY GENERAL MEETING of the Proprietors of this Association was held at the City Terminus Hotel, Cannon Street, London, on Tuesday, the 4th inst.,

THOMAS HENRY GOODWIN NEWTON, Esq., in the Chair, when the following RESOLUTIONS were unanimously passed:—

"That the Report of the Directors upon the affairs of the Association be received, adopted, and entered upon the Minutes."

"That a Dividend of 5 per cent. for the Half Year ended the 31st of December last be declared upon the £3,800,000 Capital Stock of the Association, and that the same be payable, free of Income-Tax, on and after the 11th of May next."

"That Francis Bassett, Esq., be re-elected a Director of the Association."

"That Sir James Morse Carmichael, Bart., be re-elected a Director of the Association."

"That Thomas Henry Goodwin Newton, Esq., be re-elected a Director of the Association."

"That Sir Joseph Sebag Montefiore be re-elected an Auditor of the Association."

Cordial Votes of Thanks were passed to the Directors for their able management of the affairs of the Association, to the Chairman for his conduct in the chair, also to the Staff in London and on the Continent, with especial mention of Mr. Lindon in connection with his services at Vienna.

By order of the Board,
ROBT. W. WILSON,
Secretary.

No. 21, Austin Friars, London, E.C.,
May 5, 1897.

SALE OF GAS SHARES.

THE Hastings and St. Leonards Gas Company, pursuant to their Act of 1883, invite TENDERS for 250 SHARES of £20 each, in 50 Lots of Five Shares each, to be sent to Messrs. W. B. Young and A. E. Young, Bank Buildings, Hastings, the Joint Secretaries of the Company, on or before the 2nd day of June next.

The whole amount payable, including premium, will have to be paid to the Company's account at the London and County Bank, Hastings Branch, on or before the 30th day of June next; and the new Issue will be entitled to its first Dividend from that date to the 31st of December, 1897, after the declaration of Dividend in March next.

The Directors intend to fix a Reserve Price for the Shares.

Tenders may be made for one or more Lots; and Forms of Tender and any further Particulars may be had of the Secretaries.

W. B. YOUNG,
A. E. YOUNG,
Joint Secretaries to the Hastings and St. Leonards Gas Company.

Bank Buildings, Hastings.

ISSUE OF STOCKS AND SHARES BY AUCTION UNDER PARLIAMENTARY POWERS.

MR. ALFRED RICHARDS undertakes the issuing by Auction of GAS AND WATER SHARES under Parliamentary Powers.

He also holds MONTHLY SALES of GAS AND WATER SHARES at the Auction Mart, Tokenhouse Yard, E.C.

Terms for the issuing of Capital, and also for offering to auction Gas and Water Shares, and all Particulars relating thereto, may be had of Mr. Alfred Richards.

Offices: 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
HARROW AND STANMORE GAS COMPANY.

SALE OF 500 SHARES.

MR. ALFRED RICHARDS will Sell BY AUCTION, at the Mart, London, E.C., on Wednesday, May 26, at Two o'clock, in Lots, 500 £10 "C" SHARES (fully-paid) in the HARROW AND STANMORE GAS COMPANY, ranking for a Standard Dividend of 7 per cent.; the last Dividend on the same class of Shares having been at the rate of 5½ per cent. per annum, and offering an Investment of the soundest character.

Particulars of the SECRETARY of the COMPANY, at the Gas-Works, HARROW, and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By Order of the Directors.
500 SHARES IN THE
SOUTHEND WATER-WORKS COMPANY.

MR. ALFRED RICHARDS will Sell by AUCTION, at the Mart, E.C., on Wednesday May 26, at Two o'clock, in lots, 500 £10 SHARES (to be issued as fully paid) in the above Undertaking, ranking for a Maximum Dividend of 7 per cent.; the last Dividend on the same class of Shares having been at the rate of 5 per cent. per annum.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of Executors and others.
GAS AND WATER DEBENTURE AND ORDINARY STOCKS AND SHARES IN THE

Brentford Gas Company.
Tonbridge Gas Company.
Wandsworth and Putney Gas Company.
Barnet District Gas and Water Company.
Hornsey Gas Company.

MR. ALFRED RICHARDS will Sell the above BY AUCTION, at the Mart, London, E.C., on Wednesday, the 26th of May, at Two o'clock, in lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

BY EDWIN FOX AND BOUSFIELD,
AT THE AUCTION MART, ON
WEDNESDAY NEXT, MAY 12, AT TWO, IN LOTS.
By order of the Directors.
CRAYS GAS COMPANY.
ISSUE of £10,000 THREE per CENT. DEBENTURE STOCK.

THE Company was incorporated in 1865. The Authorized Capital is £40,000, and there has been issued £40,000 (including £5161 premiums) in 1996 10 per cent. Shares of £10 each, eight 10 per cent. Shares of £5 each, and 1484 7 per cent. Shares of £10 each, fully paid. Dividends of 10 per cent. and 7 per cent. respectively have been paid since 1879. In lots to suit large and small Investors.

Particulars at Messrs. EDWIN FOX AND BOUSFIELD'S OFFICE, 99, Gresham Street, BANK, E.C.; and of the Solicitors to the Company, Messrs. MAY, SYKES, and Co., Suffolk House, LAURENCE POUNTNEY HILL, E.C.

Price 7s. 6d. per 100; £3 *per* 1000 (*Carriage Free*), *Demy 4to.*,

A LEAFLET ON

SULPHATE OF AMMONIA:

ITS SOURCE—RELATIONSHIP TO SOIL—EFFECT ON PLANTS.

By H. H. COUSINS, M.A.,

South-Eastern Agricultural College, Wye.

This is a Reprint from the "JOURNAL" of three Articles, which are of a character eminently suitable for distribution among Farmers and other users of Artificial Manures.

LONDON:
WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on Application.

E. ASQUITH & CO.,
Hydraulic Engineers,
17, Mather Street, Ancoats, Manchester,
Fit up Plants for
Pressing Anthracene, Naphthalene, &c.
Competent Men sent out to erect same. Estimates given.

PRICE'S COKE & COAL BARROW

effects a great saving of time, labour, and expense.

For Particulars, Price, &c., apply to Mr. EDWARD PRICE, 119, Queen's Road, FINSBURY PARK, N.

Prices are Reduced.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD
BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

EXTRACTION APPARATUS
SPECIALLY DESIGNED
TO EXTRACT THE SULPHUR FROM SPENT OXIDE.

BUILT BY
WEGELIN & HÜBNER, HALLE a/S.
ENGINEERS AND IRONFOUNDERS.

TROTTER, HAINES, & CORBETT,

Brettell's Estate

FIRE-CLAY & BRICK WORKS,

STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.

Proprietors of

BEST GLASSHOUSE POT & CRUCIBLE CLAY.

SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

LONDON OFFICE: R. CULL, 84, OLD BROAD ST., E.C.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

For Prices, f.o.b. Ship or Delivered by Rail, apply to

THE WALLSEND & HEBBURN COAL COMPANY, LTD.

8 Lombard Street, NEWCASTLE-ON-TYNE.

W. RICHARDSON, Fitter.

HOLMSIDE GAS COALS.

PRESENT DAILY PRODUCE OVER 4000 TONS.

LATEST ANALYSIS—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation.

Yield of Gas Per Ton . . 11,205 Cubic Feet.
Illuminating Power, 16 7/10 Stand. Sperm. Candl.
Coke (of good & pure quality) 13¾ Cwt. Per Ton.
Sulphur . . . . A little over 1 Per Cent.
Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 103 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.

PRESENT DAILY PRODUCE AVAILABLE 2500 TONS.

RESULTS OF DIFFERENT ANALYSES:—

Yield of Gas Per Ton . . 10,500 Cubic Feet.
Illuminating Power . 17 Stand. Sperm Candl.
Coke (of excellent quality) . 13½ Cwt. Per Ton.
Sulphur . . . . . 1·13 Per Cent.
Ash . . . . . 1·34 Per Cent.
Tar . . . . . 180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 94½ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COALFIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

STAFFORDSHIRE THE TUBE CO.

TELEGRAMS:
"EVESON, BIRMINGHAM."

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,

LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

JAMES OAKES & Co.,

ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts and covers, and rendering leakage impossible.

LONDONDERRY GAS COALS

FROM THE

MARQUIS OF LONDONDERRY'S COLLIERIES,

COUNTY OF DURHAM.

Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO

S. J. DITCHFIELD,

SEAHAM HARBOUR, COUNTY OF DURHAM.

THE "COOMBE" DRAUGHT SCREEN FOR INCANDESCENT BURNERS.

For Illustration and Statement of Advantages to be gained by its use, see "JOURNAL," May 4, p. 1020.

ALFRED ARCULUS & CO., Glass Manufacturers,
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THE SILICA FIRE-BRICK COMPANY,

OUGHTIBRIDGE, near SHEFFIELD

MANUFACTURE

SILICA BLOCKS, BRICKS, AND CEMENT

OF SUPERIOR QUALITY

FOR GAS-FURNACES.

Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their

GREATER DURABILITY,

Strongly recommended where EXCESSIVE HEATS have to be maintained.

BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.

Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton . .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Commercial Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Crystal Palace District Gas Company, Danish Gas Company, Bombay Gas Company, San Paulo Gas Company, Alliance and Dublin Consumers' Gas Company, Ipswich Gaslight Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For Prices, &c., apply to the

HARTON COAL COMPANY,

LIMITED,
Newcastle-on-Tyne.
W. H. PARKINSON,
FITTER.

COLUMNLESS GASHOLDERS

GUIDED BY STEEL CABLES (PEASE'S SYSTEM).

GREAT SAVING IN COST, AND ABSOLUTELY RELIABLE IN WORKING.

Write for Testimonials and Photographs.

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THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON & COAL Co., Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by

Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton	10,500 Cub. Ft.
Illuminating Power	16·9 Candles.
Coke (of good quality)	67·5 per Cent.
Sulphur	0·58 „
Ash	2·73 „

For Price, &c., apply to the

WEARDALE IRON & COAL Co., Ld.

QUAYSIDE, NEWCASTLE-ON-TYNE.

THOMAS TURTON AND SONS, Limited,

SHEAF WORKS, SHEFFIELD,

MANUFACTURERS OF

FILES OF BEST QUALITY

FOR ENGINEERS.

STEEL OF ALL DESCRIPTIONS.

SCREW STOCKS, TAPS AND DIES,

SPANNERS, RATCHET BRACES, LIFTING JACKS

ANVILS, VICES,

AND ENGINEERS' TOOLS GENERALLY.

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GAS ILLUMINATION JUBILEE DEVICES.

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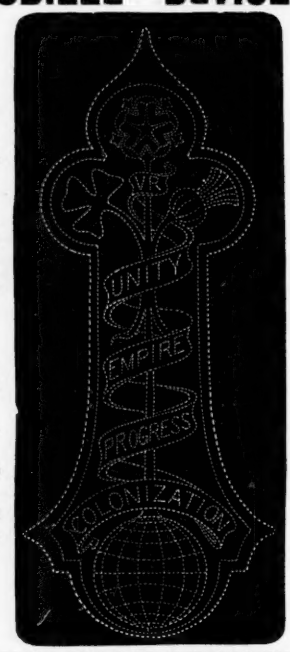

ORDER EARLY

PRICE LISTS ON APPLICATION

JAMES MILNE & SON

— LIMITED —

EDINBURGH, LONDON, LEEDS AND GLASGOW.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for

CANNEL & COAL.

TYNE

BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	17·8 candles.
Coke	70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to

THOS. W. DANCE & SONS,

Coal Owners, Newcastle-on-Tyne;

or

E. FOSTER & CO.,

21, John Street, Adelphi, London, W.C.

HEATHCOTE GAS COAL.

RICH IN ILLUMINATING POWER AND YIELD OF GAS.

ABOVE THE AVERAGE IN WEIGHT AND QUALITY OF COKE.

MAINTAINS A HIGH STANDARD IN RESIDUALS.

THE GRASSMOOR Co., Ld., CHESTERFIELD.

INCANDESCENT STREET LIGHTING.

THE ONLY SUCCESSFUL ECONOMICAL AND EFFICIENT

ANTI-VIBRATION SYSTEM.

Every Gas Engineer, Gas Manager, and Lighting Authority should adopt it.

Applicable to existing Lamps.

THE LARGEST INSTALLATION OF INCANDESCENT STREET LIGHTING IN ANY BRITISH TOWN IS ON THIS SYSTEM.

SUCCESSFUL RESULTS GUARANTEED IN ALL SITUATIONS.

Full Particulars on Application to

THE ANTI-VIBRATION INCANDESCENT LIGHTING COMPANY, Limited,

12 & 14, WESTGATE ARCADE, BRADFORD, YORKS.

WE HOLD THE ORIGINAL PATENTS.

PENNY-IN-THE-SLOT GAS-METERS,
SHILLING-IN-THE-SLOT METERS.
Every Description of ORDINARY GAS-METERS.

THE AUTOMATIC
GAS-METER (1895) CORPORATION, LTD.

ROCK METER WORKS,
TORTWORTH STREET, STRANGEWAYS, **MANCHESTER.**

JOSEPH EVANS & SONS, CULWELL WORKS, WOLVERHAMPTON.

Telegrams: "Evans, Wolverhampton." PLEASE APPLY FOR CATALOGUE No. 8. National Telephone No. 7089.

12,000 PUMPS IN STOCK AND PROGRESS.

TRADE MARK.

NO TAPPETS.

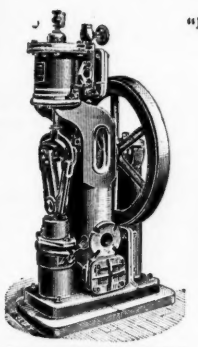

Fig. 705. "SINGLE RAM" STEAM-PUMP.

Fig. 598. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

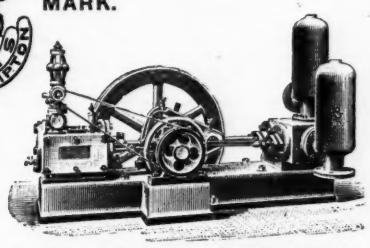

Fig. 685. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

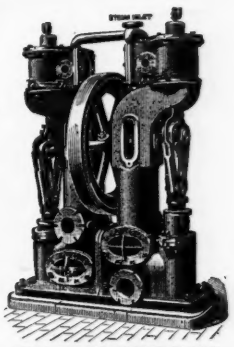

Fig. 712. "DOUBLE-RAM" STEAM-PUMP

LONDON OFFICE
60, QUEEN VICTORIA ST. E.C.

TELEGRAPHIC ADDRESSES
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"ECLAIRAGE LONDON."

TELEPHONE No. 43.
"HALIFAX EXCHANGE"

GAS ENGINEERS.
CONTRACTORS.
IRONFOUNDERS.

RETORT SETTERS.
FURNACE BUILDERS.
ETC. ETC.

JONAS DRAKE & SON

SOLE AGENTS FOR
HISLOP'S
PATENT REGENERATIVE FURNACES
—FOR—
ENGLAND, WALES & ABROAD.
RETORT BENCHES ERECTED COMPLETE
WITH OR WITHOUT SPECIAL FURNACES.
RESULTS GUARANTEED.

OVENDEN HALIFAX

Designs and Estimates on Application.

GASEOUS FIRING A SPECIALTY.

HARPER & MOORES,
STOURBRIDGE.

MANUFACTURERS OF
BEST FIRE-BRICKS, GAS-RETORTS,
LUMPS, TILES, AND ALL ARTICLES IN FIRE-CLAY.
Proprietors of Best Glasshouse Pot, Crucible, and other Stourbridge Clays.

MANUFACTURERS OF GLASSHOUSE POTS AND CRUCIBLES OF EVERY KIND.
ESTABLISHED 1836.

ARROL-FOULIS
Patent Automatic Machinery
FOR
DRAWING AND CHARGING GAS-RETORTS.

Full Particulars may be obtained from the Sole Makers,
SIR WILLIAM ARROL & CO., Limited,
GLASGOW.
[See Illustrated Advertisement, May 4, p. 1018.]

BEST & LLOYD
MAKERS OF **BIRMINGHAM.**
THE
PATENT "SURPRISE" PENDANT,
WITH PATENT SHADE.

The ONLY GAS-PENDANT suitable for Domestic Lighting; a room 18 ft. by 14 ft. being beautifully illuminated with one Incandescent Burner.

Extract from the **JOURNAL OF GAS LIGHTING**, Jan. 8, 1895.

"IN CONJUNCTION WITH
THE INCANDESCENT GAS-LIGHT
it quite **supersedes** the familar three-light pendent. We are able to bear witness to the **convenience** of the New Pendant."

G. & J. HAIGH,
Raven's Lodge Fire-Brick Works, DEWSBURY.

FIRE-BRICKS of the highest Quality, made from Fire-Clay of a most Superior and Refractory Character, suitable for **GLASS-WORKS, GAS-WORKS, and BLAST-FURNACES.**

WHITE GLAZED AND SALT GLAZED BRICKS, BUFF FACING BRICKS, &c.

For Prices and Analysis, apply as above.

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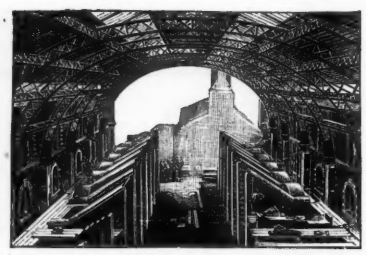

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Improved
PATENT SCRUBBER-WASHERS,
All sizes,
From 50,000 to 5,000,000 Cubic Feet of Gas per day.
Results unrivalled. Send for Particulars and Prices.

MALLEABLE
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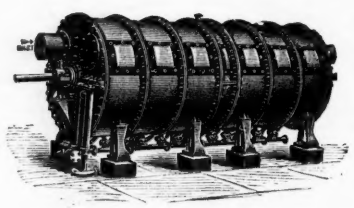
CASTINGS.



GASHOLDERS of Improved Construction and of all Sizes.
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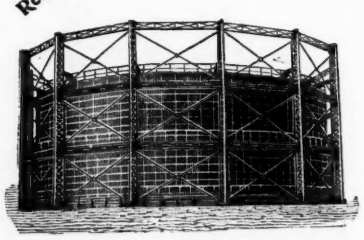

Improved
BYE-PASS and CENTRE-VALVES, GOVERNORS, and METERS.

Rotary or Pump
EXHAUSTERS.

80, CANNON STREET, LONDON,
AND
WHITESTONE IRON WORKS, HUDDERSFIELD.

JOHN BROWN & CO., LTD., SHEFFIELD.

Proprietors of

ALDWARKE MAIN, CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

ALDWARKE MAIN GAS COAL

Analysis: 12,600 Feet of 19-Candle Gas per Ton.

Value in Pounds of Sperm, 820·80.

VERY FREE FROM IMPURITIES.

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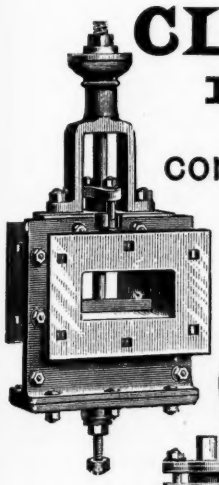
OF

CLAPHAM BROTHERS, LD.,

KEIGHLEY, YORKS.

— ESTABLISHED 1837 —

CONTRACTORS TO HER MAJESTY'S GOVERNMENT.



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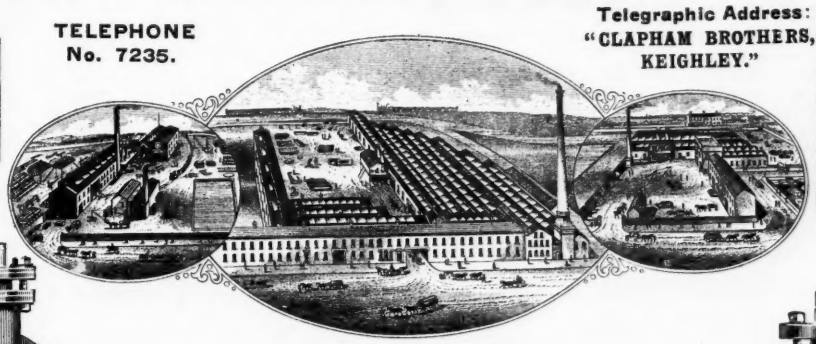
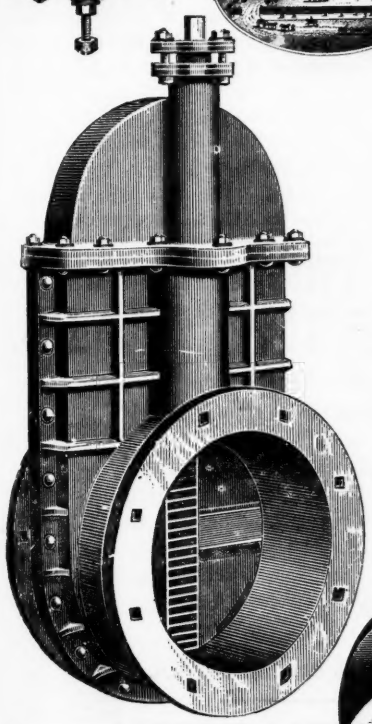
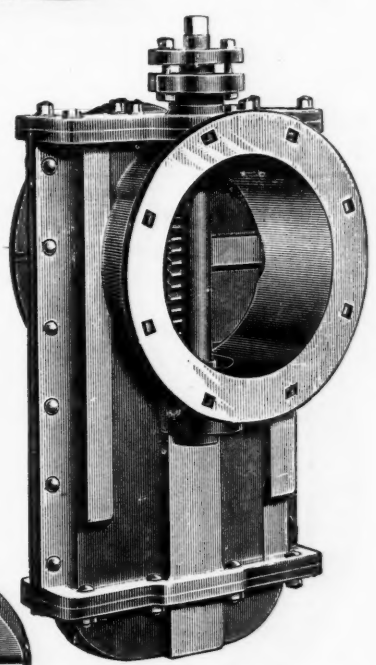
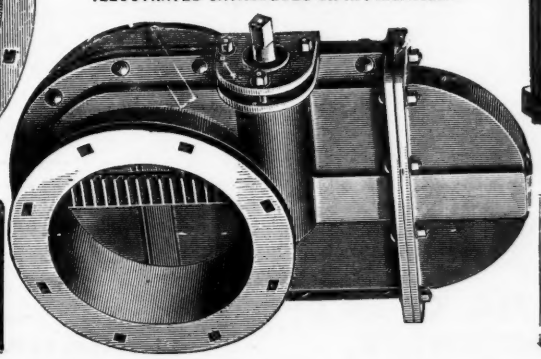
Telegraphic Address: "CLAPHAM BROTHERS, KEIGHLEY."





ILLUSTRATED CATALOGUES ON APPLICATION.





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RETORT-FITTINGS, PATENT CONDENSER, PURIFIERS, WITH PLANED JOINTS.

WATER VALVES & MAINS, and all kinds of Gas-Making Apparatus and General Ironwork.

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Established 1860.

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BEST QUALITY.

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[See Illustrated Advertisement, May 4, p. 1015.]

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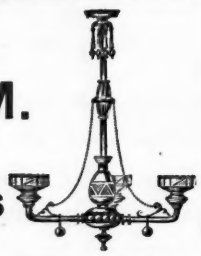

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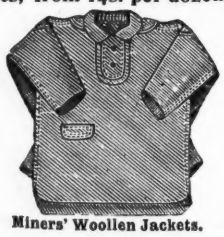

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High Water-Boots.

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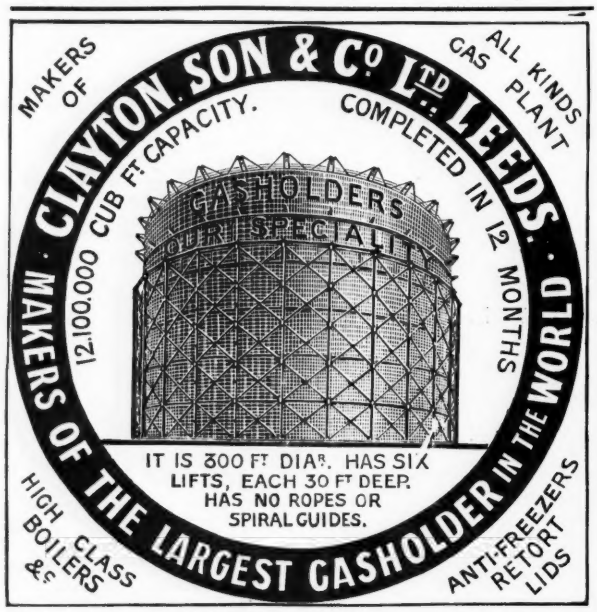
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12,100,000 CUB FT CAPACITY.
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IT IS 300 FT DIAM. HAS SIX LIFTS, EACH 30 FT DEEP. HAS NO ROPES OR SPIRAL GUIDES.
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THE
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A 280-CANDLE POWER PLAIN IRON LAMP,

CLASS A– 55/-

LIGHT for LIGHT less than half the price of any other Regenerative Lamp.

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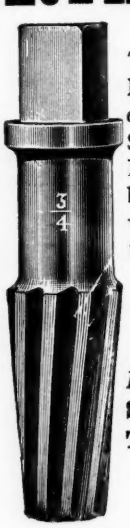
Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

RETORTS CAREFULLY PACKED FOR EXPORT.

Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

PATENT TWISTED TAPER
RYMERS & TAPS.



These **Patent Twisted Taper Rymers and Taps** are the best ever made for Gas and Water Service Connections. A true Hole and a correct Thread can be assured. They are easy to work, and will last much longer than straight grooved Taps and Rymers.

THOUSANDS ARE IN DAILY USE.

Also SCREWING-MACHINES, STOCKS and DIES (with Patent Twisted Dies), PIPE-TONGS, and other TOOLS.

Apply for Prices and Particulars to

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NATURAL BOG ORE FROM OWN MINES.

Samples and Prices on application.

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SUPPLY FROM STOCK

CAST-IRON RETORTS,

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SOCKET-PIPES FOR GAS OR WATER PURPOSES.

FLANGE PIPES FOR STEAM.

Sole Manufacturers of LYON'S "PATENT" GAS-MAIN SYPHONS.

AGENTS FOR

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WORTLEY FIRE-CLAY WORKS,

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Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—

1. Smooth interior, preventing adhesion of Carbon.
2. They can be made in one piece up to 10 feet long.
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MACHINE-MADE GAS-RETORTS.

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IMPROVED

Sulphate of Ammonia Apparatus.

The most successful and approved Apparatus known up to the present time.

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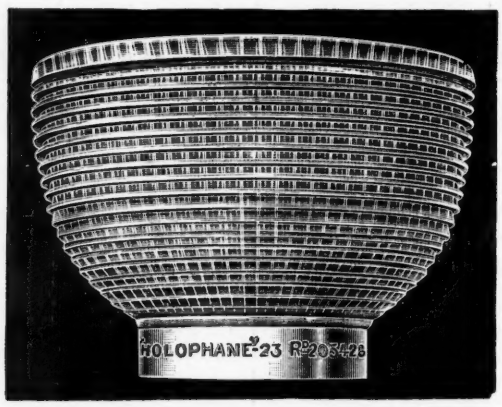

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